AMATEUR WORK

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INDUCTION COIL MAKING FOR AMATEURS.

FRANK W. POWERS.

II. Section Winder and Winding.

Except in coils giving sparks of $\frac{1}{2}$ in., or under, it is advisable to wind the secondary in sections. Unless this is done, the difference in potential between adjacent turns of the wire will be so great as to produce internal sparking; the insulation will eventually break down and a "short circuit" caused, requiring rewinding, a matter which at best is quite difficult with the fine wire used.

The number, size and thickness of the sections depend upon the size of the coil, and as complete specifications were given in the October, 1905, number of this magazine, they will not be repeated here. For illustration, the dimensions and work for a coil giving a 4 in. spark will be given. This size is a very handy one for the amateur, as it is large enough, when used in series with a Tesla high-frequency coil, to do excellent X-ray work, and most of the experiments for which induction coils are used.

It may be well to state at this time, that coils for wireless telegraphy are wound with a larger wire in the secondary, than are those for X-ray and similar work. For wireless telegraphy the desideratum is a strong, fat spark, rather than a thinner one of higher potential, and this is obtained by using No. 32 or 34. B. & S. gauge in place of No. 36. If the coil is desired for various uses, the No. 34 gauge will best fill the requirements.

First let us consider the winder. If possessed of a small lathe, and the occasional cleaning off of wax drops is not objectionable, the attachments to be described can be fitted to the lathe. Otherwise it will be best to purchase a polishing head, similar to the one shown in Fig. 2. Be sure that the collars on the spindle run true and the movable collar fits fairly tight on the tread on the spindle. A polishing head sufficiently well made for the requirements can be purchased at most hardware stores for about $1.25.

A set of three face plates, *A*, *B* and *C*, are made to fit on the spindle, as shown in Fig. 3. These are made from sheet brass or planished steel about $\frac{1}{8}$ in. thick and $4\frac{1}{4}$ in. square, which should be perfectly flat and smooth. An easy way to make them is to first bore a hole in the center, the size to fit the spindle with a snug fit. Then place between the collars and screw up

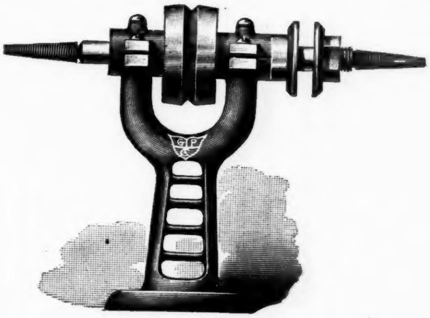


FIG. 2.

the outside collar to hold tight. By mounting the polishing head on a board and clamping to a sewing machine table and belting up to the treadle wheel the polisher can be rotated at a high speed. With a diamond point turning tool, cut the brass plate to a circle $4\frac{1}{4}$ in. diameter, rounding off the edge and smoothing with emery cloth.

Two collars, *W*, are then made of wood $\frac{1}{4}$ in. thick and $2\frac{1}{8}$–$2\frac{1}{4}$ in. diameter, the circumference being turned to a slight bevel, as shown. This bevel is to facilitate the removal of a section after the winding. Holes are drilled in the plates at *a*, *b* and *c*, through which to run the ends of the wire, and small, round-head brass screws, *d*, *e* and *f*, are put in for temporarily fastening the ends by giving a turn or two of the wire around them.

The winding is done in what may be termed double sections, as follows: The plate *A* and *B* with a collar

between are placed on the spindle, the end of the wire from the spool, after passing through the hot paraffine wax, is put through the hole *a* and turned around the end of the screw *e*. The open space is then carefully wound with the wire until the required amount has been put on. Cutting the end with spare wire of several inches, put the end through the hole *a*, and around the screw *d*.

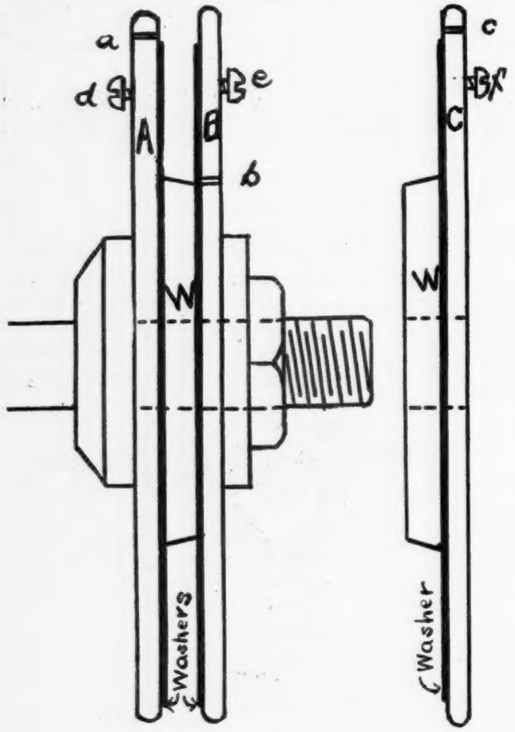


FIG. 3.

The wax will coil quickly so that the section and face plates can be removed from the spindle; in fact, the difficulty will be to keep the wax and wire hot enough to retain the wax soft enough to enable the necessary quantity of wire to be wound on each section. One way of doing that is to suspend the spool containing the wire in the wax tank, in this way bringing wire and insulation to the same heat as the wax, when it will not cool as rapidly as when only drawn through the wax.

The thickness of the sections mentioned above is rather greater than many authorities specify for a coil of this size, but the writer has had no difficulty with breaking down of sections of this thickness, and if care is taken throughout the work of winding the results should be satisfactory, and the labor is reduced almost one-half over what it would be with sections ⅛ in. thick. Some makers carry this fineness to the extent of sections only 1-16 in. thick, and readers who are doubtful about their ability to wind carefully can use the 1-8 in. section to good advantage, in which case the collars *W* should be of that thickness.

After removing the first section, the face-plate *c* is put on with a collar *W*, facing the same as did the face-plate *A*. The wound section is then put on after turning around and removing the face-plate *B*, the end of the wire which passed through the hole *b*, is soldered to the end from the spool, the joint is well covered with cotton thread and coated with wax applied with a small bristle brush. Great care must be taken with these joints, both in the soldering and subsequent insulating of them. In winding the section, the spindle

FIG. 4.

must turn in the same direction, as with the first section, and the wire fed in just the same, as the turning around of the first section has obviated the necessity of changing the direction of winding every other section. Mention should now be made of the paper washers which are placed against each face-plate before winding. These are made from a thin, porous cardboard or thick pulp paper; the kind which will readily absorb wax being needed. They are cut out with a washer cutter, or sheets to the thickness of ⅛ in. may be placed between two thin pieces, such as picture backing, the circles marked out with dividers, and the cutting done with a fret saw. A washer cutter, Fig. 4, that will make both the inside and outside cut at the same time, and having a capacity up to 6 in. can be obtained for about 75 cents and is recommended.

The outside diameter of the washers is a trifle greater than the winding, the hole inside will be 2 1-8 for one half and 2¼ in. for the other half. It will probably be necessary to sharpen the knives of the washer cutter to secure a clean cut and avoid tearing. After cutting out a stock of washers they are dipped in a pan of warm paraffine wax, and then after the wax is set, smoothed with a warm flatiron. The iron should not be so hot as to cause the wax to run, but simply to enable it to slide freely without gathering wax, which a cold iron will not do.

When winding sections, washers are first put on flat against each face plate. After completing the first part of a double section and in preparing to wind the second part, a washer on the second part will divide the two parts. If the washers are made of thick paper, a second washer should be added before commencing to wind the second part. When the double sections are assembled, each part will then be divided by two washers. If cardboard is used, one outside washer is removed from each double section when assembling them.

It is well to number each double section with a pencil as the winding proceeds, and to store them until all are completed in a covered box to avoid dust or accidental injury. It is customary with the first few sections to wind on several turns of paper before starting the wire. To do this cut the paper, which should be very strong and well waxed, into strips long enough to make several turns around the washer *W*. The object of this is to give added space between the secondary winding and the primary, as the sparking tendency is greatest at the ends of the coil, and most breakdowns occur there.

It may be well to state that in winding the secondaries of coils for wireless telegraphy, and using the coarser wire to obtain the equivalent spark length of a coil wound with finer wire, it is necessary to use more wire, consequently the sections will be of greater diameter. Spark length is not so important, however, and if, in using the specifications for a 4 in. spark and the coarser wire, a white, heavy 3 in. spark is obtained, the result may be considered as quite satisfactory.

BOOKS RECEIVED.

ENGINEERS' TURNING. By Joseph Horner. 404 pp., 8 x 5½ inch. Price $2.50. Crosby, Lockwood & Sons, D. Van Norstrand Co., New York.

A name that would more nearly indicate the contents of this book to American readers would be:—"The Metal Working Lathe," as the entire volume is devoted to that tool. For this reason, the treatment of the subject is much more complete than with books treating of all the tools of a shop. The author is well known to readers of technical books as a skilled writer, and this book fully equals, and in some respects surpasses, its predecessors. Anyone desiring to know lathe work in all its branches will find this book of the greatest value, as the illustrations are numerous and well drawn and the text clear and practical.

The book is divided into six sections, the first giving a full description of the lathe and its parts, including the special features peculiar to lathes of both American and English make. The second section treats of turning between centers, and section three takes up work supported at one end. In section four internal work is fully described, and section five covers screw cutting and turret work. The closing section includes miscellaneous matters, such as grinding, tool holders, speeds and feeds, tool steels, etc.

The above brief mention of the contents is sufficient to show how great a help the book would be to the apprentice, although its value is almost equally great for the regular lathe hand who desires to learn the most approved methods of turning out work. For teachers of metal working in manual training schools the book cannot be too highly commended.

INDUSTRIAL SCHOOLS IN BELGIUM.

Consul McNally, of Liege, says that in no country in the world does the government attach more importance to the industrial and professional education of its people than in Belgium. While some of the industrial and professional institutions are maintained by the grace of the central government, the majority are subsidized by the provincial or communal administrations. The city of Liege supports one large industrial school and nine professional schools.

The industrial school is one of the best in Belgium and has at present an attendance of 650 pupils. Many of its graduates have become noted in the industrial world.

The professional schools include one for tailors, where the lectures and practical work of a tailor as taught in conjunction are free. The course is five years. The school of horticulture is free, with a course of three years.

The commercial and consular high school is intended to offer an advanced education, both theoretical and practical, and is open to those contemplating the profession of banking, commerce, industry or a consular career. The government usually drafts from the graduates the young men wanted in the various consulates throughout the world, where they remain without compensation during a preliminary prescribed period.

The firearm school was established in 1897, and like the other schools the applicant for admission must have had a primary education. Every detail from the stock making to the barrel is taught, and the boys must pass an apprenticeship in every branch of the gun-making industry. The lectures include both the theory and practical information of firearm making.

The remaining schools embrace tanning, house painting, mechanics, plumbing and carpenter work. The mechanical school includes the study of political economy, hygiene, arithmetic, geometry, drawing (mechanical), physics, chemistry, mechanics, wood and iron work, bicycle and automobile making.

Plumbing is the only school in which an entrance fee is demanded.

"Professional jealousy is a public acknowledgment of inferiority on the part of the one who is jealous."

PHOTOGRAPHY.

METOL-HYDRO. AND ITS ADVANTAGES.

CHESTER F. STILES.

In comparing metol-hydro developers, recommended by the makers and others, one is at once struck with the difference between the various proportions of metol to hydrokinone. The metol-hydrokinone combination is an extremely popular one, proven by its universal use for films.

It is a notorious fact that hydrokinone is faulty in its rendering of tones in the negative, especially in under exposures. When the temperature of the solution is low, hydrokinone becomes inert and its developing energy ceases. Metol, on the other hand, is little affected by temperature conditions, and searches out the minute detail of the negative even in the deep shadows. If metol, on the other hand, has any fault it is in its lack of density power, but the hydrokinone supplies this deficiency and makes, with the metol, a most harmonious developer, which is always under perfect control.

The metol-hydro combination may be worked separately if desired. That is, we may make up a developer of metol and one of hydrokinone; use our metol first to get the image started and follow it up with the hydrokinone portion. By watching the action of the hydrokinone, we shall be convinced that it plays more the part of an intensifier than of a straight developer. This is proven by the fact that it seems to add density to a metol image at a temperature that it would have failed in straight developing without the metol.

In other words, it takes the active metol to attend to the faint impressions of light and overcome the "inertia" of the plates. Just as a bicycle wheel, once set in motion, continues its movement for an appreciable time, so does the hydrokinone pile on its share of the density after being pushed into activity by the metol.

Eminent German scientists have made some very searching investigations on the energy of various metol-hydro mixtures. By careful experiment it has been found that a mixture of two parts hydrokinone to one of metol is equal in strength and energy to that of three parts of straight metol. This curious fact suggested the existence of a definite chemical compound of metol and hydrokinone, and experiments prove the conclusion.

Lumiere Bros and Seyewet, Jr., of Lyons, France, announced the discovery of such a compound. Curiously, it explained some troubles which have occasionally been encountered in compounding metol-hydro combinations. The writer has heard several times of the developer chemicals being precipitated and made insoluble when being made up, and it being reasonably certain that cold solutions were not the fault, the trouble was looked for elsewhere.

The writer had several times mixed very concentrated solutions of metol and hydrokinone with similar concentrated solutions of anhydrous soda sulphite. A precipitate formed, and on distribution seemed to dissolve, showing that the precipitate was insoluble in the stronger sulphite but soluble in the weaker. Adurol gave a similar precipitate. The developers which precipitated were those whose metol and hydrokinone presumably were in the exact proportion to form the precipitate, and the strong sulphite of the concentrated developer, of course, prevented its solution.

No attempt was made to explain the precipitation of the concentrated metol-hydro solutions, for the Lumiere researches suggest a satisfactory reason.

We would, therefore, recommend the use of metol and hydrokinone in proportions of one to two respectively, and it will be seen that the price of this metol-hydro mixture is but slightly above pyro. Considering the energy of metol-hydro against the pyro, we find the former much the cheaper, and the keeping qualities are such as to enable one to keep strong stock solutions on hand for a long time.

It is desirable, where possible, to use distilled water in making up developers. Developers made with boiled water are also quite satisfactory, as the boiling serves a twofold purpose of expelling the contained air, which oxidizes the developer on one hand, and on the other by preventing the bubbles in the developer from reaching the plate. A number of small bottles filled to the neck will be found more stable in keeping qualities than one large bottle.

Metol-hydro is universally used for developing papers that print by gaslight. The formula below may be used with equal success on plates or films if diluted somewhat.

Metol	60 grains.
Hydroquinine	120 "
Water	32 ounces.

Then add 12 ounces of a sulphite of soda solution testing 60° by hydrometer. Be sure to rinse the white sulphate deposit from the sulphite crystals, if crystals sulphite is used, before the 60° solution is made. Next add 12 ounces of carbonate of soda solution testing 30° by hydrometer, and 240 minims of a ten per cent solution of potassium bromide.

The order of mixing noted above gives a clear solution which is approximately equal to the ready-for-use

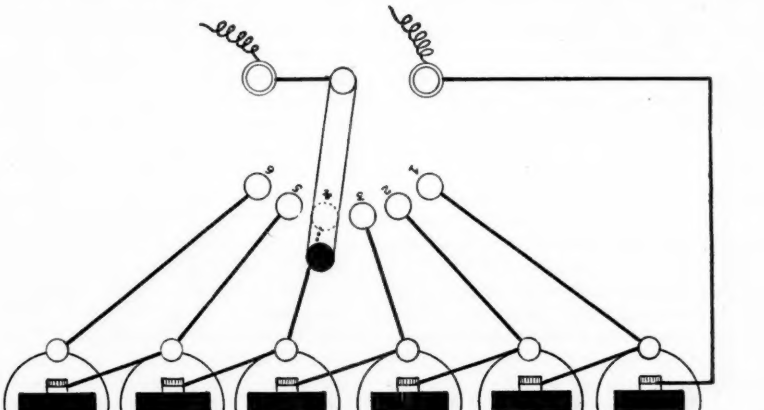
Velox developers on the market. The quantity of bromide necessary varies according to the water used. Velox prints usually reach their maximum density in about 20 seconds, therefore enough bromide should be added to keep an unexposed sheet from fogging in the developer until 30 or 40 seconds have passed. Perfect balance between the developer and the restrainers gives crisp blacks and avoids the dirty green tones.

Hydrokinone comes in snow white crystals which dissolve easily in water to a colorless solution. We cannot too strongly recommend the use of a pure sulphite in making up developers, especially anhydrous c. p. sulphite. Because of its compact nature, it is easily weighed, and while dry it is practicalty unchangeable, besides being more economical on account of the greater strength. If you must use crystal sulphite, rinse it from white impurities of sulphate which are almost always present. Should you weight white crystals in making up solutions, an error is being introduced and the sulphite will come out too weak. A slight rinsing will dissolve the sulphate impurity, since sulphate is extremely soluble. Roll the crystal sulphite thus rinsed upon blotters, and then weight it. This method is accurate enough.

Adurol is a modified hydrokinone. It has several good features, but the greatest is its advantage over hydrokinone in not being affected by temperature. Metol and adurol make a fine combination, and it gives graduations which are unequalled.

DEVICE FOR CONNECTING CELLS.

M. M. HUNTING.



It is sometimes necessary in making small electrical apparatus to test the work with one or more cells of battery. To avoid the trouble of connecting up several cells to do this work, I constructed a switch similar to the sketch here shown, which permits me to use one to six cells, as the case may require.

The switch is screwed on one corner of my workbench, the battery is on a shelf underneath. Two binding posts on the base of the switch form a convenient way to attach the apparatus to be tested. A battery of any number of cells may be arranged in this way, a point of the switch being added for each cell.

FREE INDUSTRIAL ALCOHOL.

In connection with the recent agitation for free inindustrial alcohol, the Ways and Means Committee of the House of Representatives has had hearings on the subject in Washington, when an interesting memorandum on the subject was presented by Prof. Elihu Thomson. We quote some portions of it as follows:

"Gasoline as well as kerosene has the great disadvantage that it floats upon water and is distributed by water. It is a well known fact that it is commercially useless to attempt to extinguish burning gasoline or kerosene by water alone. The use of water may, in fact, be a positive disadvantage in floating the burning material over considerable places in spreading fire. Not so with alcohol, which mixes with water in all portions, and which is at once diluted and prevented from remaining combustible.

We have recently tried at the Lynn works of the General Electric Company a Deutz alcohol engine, a type of engine made in Germany especially for use with alcohol, and the results have been such as to prove without a doubt the entire suitability of alcohol, f cheap enough, as a fuel for internal combustion engines. This particular engine is to be sent to the Island of Cuba and coupled to a dynamo for lighting. It will be operated with the cheap Cuban alcohol, which

is, I am informed, sold there at about 12 to 15 cents per gallon. A few gallons of this alcohol were obtained and used in our tests here, and it was found to be a a high grade spirit, containing 94 per cent alcohol to 6 per cent of water, or about 91 per cent alcohol by weight.

While it is not methylated or denaturalized, there is no question that the behavior in the engine of denaturalized or methylated spirit would be identically the same as with the pure grain alcohol. To obtain this sample of Cuban alcohol it was necessary that we pay an import duty of $4 per gallon, with other charges, which made the cost of the material used in testing enormous as compared with its actual value in Cuba, and I may here remark that, as in testing an engine of this kind a considerable quantity of alcohol will be used, manufacturers in the United States would suffer a considerable disadvantage in building such engines as compared with those in a country where methylated spirits, untaxed, is obtainable. In fact, the cost of the material for testing the engines is probably a sufficiently strong deterrent just now to prevent the manufacture being taken up in the United States. The island of Cuba is, however, an excellent field for the use of such machinery, on account of the low cost of alcohol.

It may be mentioned here that our experiments developed the fact that alcohol is suitable as a motor fuel even when it contains as high a percentage as 15 per cent of water. Notwithstanding the fact that the heating value of alcohol, or the number of heat units contained, is much less than in gasoline, it is found by actual experiment that a gallon of alcohol will develop substantially the same power in an internal combustion engine as a gallon of gasoline. This is owing to the superior efficiency of operation when alcohol is used. Less of the heat is thrown away in waste gases and in the water jacket. The mixture of alcohol vapor with air stands a much higher compression than does a mixture of gasoline and air without premature ex plosion, and this is one of the main factors in giving a greater efficiency.

The exhaust gases from the alcohol engine carry off less heat. They are cooler gases. It is well known that the exhaust gases from a gasoline or kerosene engine are liable to be very objectionable on account of the odor. In our tests of the Deutz alcohol engine there was absolutely no such objection with alcohol fuel, the exhaust gases being but slightly odorous, or nearly inodorous, but what odor there was, was not of a disagreeable character.

There is just now the beginning of a large development in the application of the internal combustion engine to the propulsion of railroad cars on short lines as feeders to the main lines. In this case an ordinary passenger car is equipped with a power compartment at one end, in which there will be installed an engine of, say, 200 h. p. of the internal combustion or explosion type. The growth of such a system is liable to be hampered in the near future by the cost of gasoline as a fuel, and the difficulties of using kerosene are still quite considerable. Especially is the exhaust likely to be offensive. In this case alcohol, which could be produced in unlimited amount, could be substituted.

It may be mentioned in conclusion that the efficiency —that is, the ratio of the conversion of the heat units contained in the fuel into power—is probably higher in the alcohol engine than in engines operated with any other combustible, and doubtless, on account of comparative newness of the alcohol engines, there is still room for improvement in this respect."

A copy of the bill introduced in the House by Mr. Calderwood making ethyl alcohol free, if rendered undrinkable, has now been circulated with a petition for signature. Accompanying the bill is a very interesting pamphlet going over the whole field of arts and industries, pointing out the manufacturing and other purposes for which untaxed denaturized alcohol would be used, and arguing that the development of many important industries is hampered by an excessive alcohol tax. Reference is made, for example, to use in lacquer work, where the solvent is the principal item of cost.

Special note is also made of the use of shellac and alcohol in binding together the coil or layers of wires in motors and generators. The use of this alcohol-shellac solution is also noted in regard to the manufacture of mica and other insulating material used in electrical machinery.

TOKEN MONEY IN WAR TIMES.

Token money is doubtless a thing of the past, says the "Mining World". Token money is a name applied to pieces of money current only by sufferance and not coined by the authority of the state or government. Token money abroad was quite a common occurrence fifty years ago. In the United States small coins became so scarce during the Civil War that tokens made their appearance in great quantities. They were of two classes, war or patriotic tokens and trade or advertisement tokens. Both kinds were issued with a business view, as they passed for one cent, but cost much less to manufacture. There were about 400 varieties of the war tokens coined. The first coinage of trade tokens was in Cincinnati, where 900 varieties were issued. Other cities in the West followed Cincinnati's example. In 1863, New York folks issued the famous Lindenmuller cents, of which more than a million were put into circulation. These were followed by the Knickerbocker and many others, and there were about 700 varieties coined in New York alone. There were 1200 issued in Ohio from a hundred different places, and in other states the coinage was most numerous. In 1864 the government put a stop to the coinage of tokens, but not until 20,000,000 of them were placed in circulation.

AN ELECTRIC FURNACE.

The electric furnace is a great favorite with experimentalists, in consequence of the very high degree of heat which is readily obtainable by its use, reaching from 3500° to 4000° Cent. (7232° Fahr.), while with the ordinary blast furnace 1800° C. is rarely surpassed. With the oxy-hydrogen blowpipe, a temperature of 2200° C= about 4000 F. has been obtained. It is not at all difficult either to make or to use such a furnace; and we purpose here, in the interest of such of our readers who make chemical or metallurgical experiments their hobby, to describe the construction of a small laboratory furnace, that can be actuated either from a battery of 25 bichromate or from any electric light main capable of giving a continuous current of from 8 to 10 amperes at 50 volts pressure.

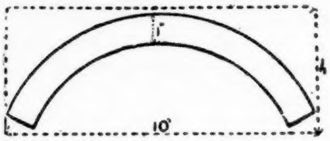


FIG. 1.

To make such a furnace, we shall begin by procuring or sewing up, a slab of slate, about 1 in. thick by 8 in. square. If not already smooth, this can be levelled by rubbing it over a flat stone surface along with fine sand and water. For the crucible, in which our melting or electrolytic operations are to be effected, we shall do well to select one capable of containing about 2 pounds of ore, and constructed almost entirely of carbon. As carbon is a very fair conductor of elec-

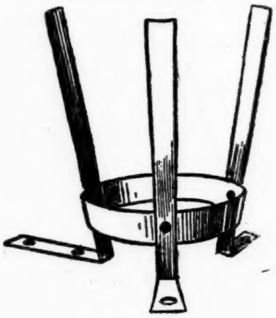


FIG. 2.

tricity, there is no necessity for using a separate negative electrode, the crucible itself serving that purpose. Besides, it is practically infusible, itself highly refractory, and does not contain any matter that would oxidize or otherwise contaminate the results of our operations. To mount this crucible in such a manner as to make a good electrical contact with the terminal that will afterwards be used as the negative of our furnace, we procure a sheet of No. 22 gauge copper about 10 in. long and 4 in. wide. On its surface, concentric to one another, we inscribe, with a pair of compasses, two segments of circles, one of 11 in. and the other 9 in. in diameter and 1 in. apart, as shown in Fig. 1.

We then cut off the superfluous metal, indicated by the dotted lines, and bend the segment, shown by the heavy black lines, into the shape of an inverted cone, which should be made to fit exactly around the bottom of the crucible; the ends overlapping by about 1 in. A mark should now be made at the center of the overlapping portions, a hole put through both, and the conical ring thus formed, joined together by riveting through this hole with a flat-headed copper rivet, carefully hammered smooth.

From a strip of hard brass ribbon, about No. 30 gauge and ½ in. wide, we cut three lengths, one being 9 in. long, the other two only 7 in. We bend all three into the shape of a letter L, the two latter having the horizontal portion only 2 in. long, while the former has

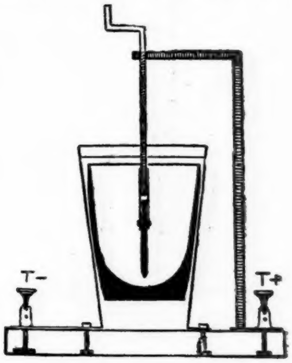


FIG. 3.

its horizontal portion 3 in. long. These we rivet at three equi-distant points on the circumference of our conical ring, so that the ring stands 1 in. from the shorter limbs, which are then bent more acutely, so as to allow the tripod thus formed to stand quite level on its three feet. See Fig. 2. A 3-16 in. hole is now put through the center of each of these feet, the tripod with the crucible firmly pressed down in it, is placed centrally on the slate slab, with the longer foot pointing to one of the corners thereof.

At the points where the holes have been made through the feet, marks are made on the slate slab, the tripod removed, and three holes, countersunk underneath, are put through the slate at these points, into which three small metal screws are inserted from below, these screws being fitted with nuts to hold the

feet in position. From a strip of thin brass ½ in. wide a perfectly cylindrical ring, 3½ in. diameter, is now made by riveting the extremities together. This ring is used to draw the three prongs of the tripod towards one another, when the crucible has been placed between them, and this conduces to produce good electrical contact between the tripod and crucible. It is needless to say that the prongs of the tripod must be curved inwards, so as to follow as nearly as possible the curvature of the crucible.

A hole should now be made near the extreme end of the longer foot of the tripod, extending through the slate base, and here should be inserted and screwed in the shank of a fairly stout terminal fitted with a nut below. In the opposite corner of the slate we now drill a full ½ in. hole and countersink it underneath. We now take a round iron rod, ½ in. in diameter, and file, or better, turn down 1½ in. at one extremity, on which we put ¼ thread by the aid of a screw cutting die. Inserting temporarily the screwed end of this rod into the hole just made, we make a mark on it, at such a height as will clear the mouth of the crucible and its clamping ring by about 5 in.

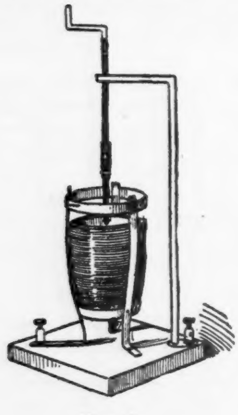


FIG. 4.

We then red-hot the iron rod and bend it neatly and squarely at right angles at this point, and afterwards cut off at the bent end, whatever projects over ¼ in. of the center of the crucible. At this extremity of the rod, exactly in line with the center of the crucible we drill and tap to ¼ in. Whitworth, a hole, in which we fit a screwed brass rod about 9 in. long, bent twice at right angles, so as to form a handle to the screw itself.

We now take a piece of solid drawn brass tube, 2 in. long 3-16 in diameter inside, and with a ¼ in. tap, put in it a ¼ in. female thread for a depth of about ¼ in., so as to grip firmly the end of the screwed brass rod. With a fine hack saw we split the tube in four quarters for a length of about 2 in., at the opposite end and fit this with an outer ring, which should be a sufficiently tight fit to bring the sides of the split ends together. This tube serves as the carbon holder, the carbons to be used with it being known as the "6 millimeter," or ¼ in. size.

These carbon rods should be about 4 in. long and at least 2 in. should be inserted into the tube or holder. An oval brass washer, 1½ in. long by 1 in. wide, with a ¼ in. hole at one extremity, is now put over the 1¼ in. screwed end of the bent iron rod; this is inserted in its hole in the slate base, care of course being taken that the center of this iron rod and its carbon holder coincide with the center of the crucible. Lastly, we drill a hole through the extended portion of the brass oval washer, and partly into the slate base and fit therein a second terminal similar to the one at the opposite corner. To use this furnace, which we represent in section at Fig. 3, and in perspective at Fig. 4, it is only necessary to connect up the positive pole of the battery or dynamo to the terminal T+, the negative to T—, and lower the carbon by means of the screw S, until the arch has been struck between the carbon rod and the bottom of the crucible, immediately pouring into the crucible a little of the material to be operated upon, being careful to maintain the arc, by duly lowering or raising the carbon rod, and adding more material in proportion as it becomes fused or electrolysed. —"Hobbies," London.

Speaking of industrial education in the United States, Heinrich Back, of the industrial school at Frankfort-on-the-Main, Germany, expresses surprise that our government has taken no steps towards providing systematic training of its citizens in industrial lines. This is at present entirely in the hands of philanthropic individuals, and no schools intended for teaching trades have been established by government effort. In the larger cities, good schools such as the Drexel Institute of Philadelphia, Pratt Institute in Brooklyn, and Lewis Institute in Chicago, have been established, but there are large sections where it is impossible for boys to obtain any industrial training. This is in direct contrast to the policy of the German government, which maintains in every part of the empire good trade, industrial and technical schools.

The proper site for a windmill, where there is no danger of its being blown over, has been generally supposed to be a place sheltered by trees or barns. Actually, however, the safest place is on a hill, where the wind can strike it equally from all directions. In such a location shifting winds are less pronounced than behind buildings or hills, and it is also found that there is less lifting force to the wind in the open than behind structures.

A gallon of water, U. S. standard, weighs 8⅓ pounds and contains 231 cubic inches.

A 9-FOOT ROWING OR 12-FOOT POWER TENDER.

CARL H. CLARK

III. Canvas Covering—Interior Fittings.

The planking having been completed and smoothed off it may be left for the present and some of the inside fittings put in. These fittings should be put in before covering the boat with canvas, as they may then be fastened with through rivets, and be much stronger than otherwise. The gunwales having been fitted as already described, and fastened by riveting through the top streak, the ends of it are fitted with knees as shown in Figs. 6 and 7.

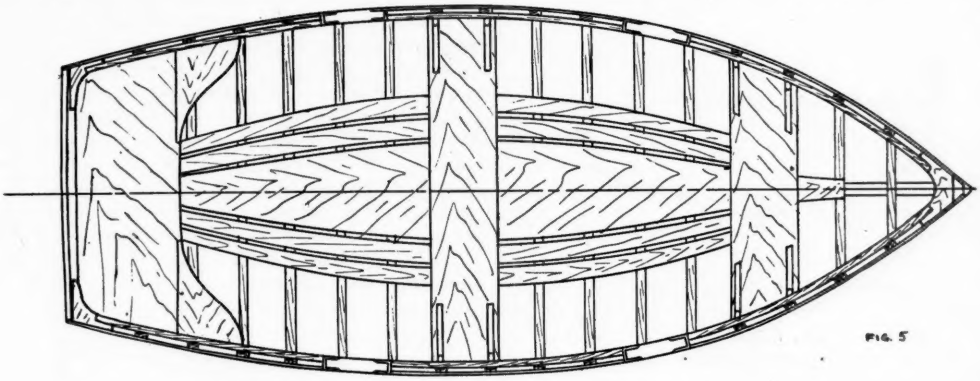


FIG. 5

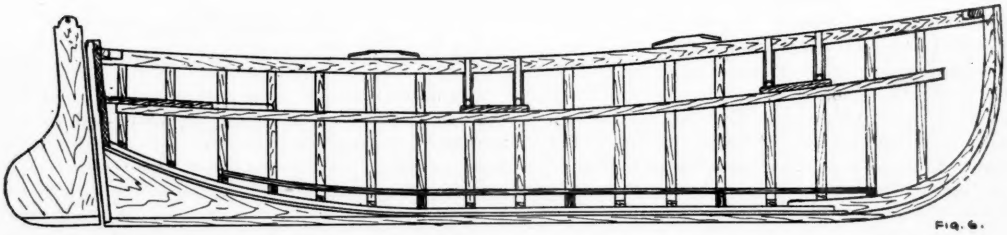


FIG. 6.

These knees are to be of natural growth and are 1 in. thick in the small boat, and 1¼ in the larger. They fit in against the top streak as shown in Figs. 7 and 10 and the gunwales are let into them and fastened by rivets through the top streak. In as light construction as that being described, all fastenings wherever possible, should be riveted through, as screws or nails do not hold sufficiently strong in the light stock. The knees at the stern may, however, be fastened to the sternboard with brass screws.

The strips to support the seats should next be fastened in place, extending the full length of the boat. For the small boat these strings are 3 x 1¼ in. of either pine or cypress, and are fastened with their upper edges 6½ in. below the gunwale. They should be through riveted, with the head of the rivet on the outside of the plank and the burr on the inside of the strip, a rivet being driven through each frame. For the large boat these strips are ½ x 2 in. and are fastened 7½ in. below the gunwale. The strips, besides supporting the seats, materially stiffen the boat.

The seats are next to be fitted; they are ⅝ in. thick and 8 in. wide in the small boat and 9 in. wide in the larger. The ends are notched to bear against the frames and should be clear of the plank about ½ in. Each seat has four knees, as shown in Figs. 5 and 6; they are of hackmatack or other suitable knee stock, ⅝ in. thick for the 9 ft. boat, and ¾ in. thick for the 12 ft. They are shaped as shown to fit between the seat and frame, and are notched out around this gunwale. A rivet should be driven through the upper end of the knee and the gunwale to the outside of the top streak and another through the lower end and the seat. The remainder of the fastenings may be brass screws driven into the knee from the outside, and into the seat. The seats

should be of pine or similar light stock or, if desired, mahogany may be used. If the edges are beaded it adds a finish and makes a more workmanlike piece of work.

The after seat is shaped as shown and is 12 in. wide in the narrowest part in the 9 ft. boat, and 15 in. for the 12 ft. It rests on and is fastened to the supporting strips with brass screws.

Several heavy floor timbers must be fitted to support the engine bed; they rest on the top of the frames in the same manner as already described, and are 1½ in. thick and about 3 in. deep above the keel. Their tops should all be in the same level to facilitate fitting the bed. For fastening, the ends should be well riveted through, and screws driven at intervals, with a heavy screw into the keel amidships.

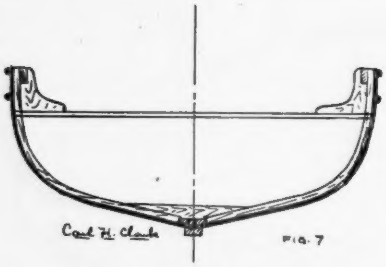


FIG. 7

All the outside fastening being complete, the boat is ready to cover with canvas, after all projecting nail or rivet heads have been driven tight, or else filed off even, so that the surface is smooth again. As there may be some rather wide seams which would cause cracks in the canvas after some use, the outside should be covered with two or three layers of tough manila paper. It will be necessary to put this on in rather narrow strips over the seams on account of the curvature of the surface, as all wrinkles must be carefully avoided. Shellac should be used to stick on the paper, a liberal amount being used, as the paper must be thoroughly protected from the water. The space to be covered with paper should be covered with shellac, the paper laid on, and it in turn shellacked, each layer being treated the same. The various pieces should overlay as seldom as possible, so as to keep the same thickness all over. Any unevenness in the final coating should be rubbed down with sandpaper after the shellac is dry. This paper coating also adds to the strength of the boat.

The next work is to put on the canvas covering, which is, perhaps, the most troublesome part of the whole work. Canvas for this purpose should be of No. 12 weight for the small boat and No. 10 for the large one. It can be obtained in all widths, and should be wide enough to put on in one piece. For fitting the canvas the boat should be fastened down securely, as a considerable amount of force will be exerted in pulling the canvas into place. For fastening the canvas, copper tacks about 5-16 in. long are to be used; some difficulty may be found in driving them into the oak, in which case tinned iron tacks may be used, but only where necessary.

The outside of the boat should be well covered with rather thick paint. The canvas is then laid on and tacked along the straight part of the keel; and is split at the ends where the curves of bow and deadwood begin. The ends are then carried over so as to make it fit as nearly as possible and tacked temporarily; the middle portion is then drawn tight and tacked to the lower edge of the top streak with tacks about 1 in. apart. It may then be tacked on either side of the middle, working gradually towards the ends, care being taken to pull it out lengthwise at the same time, to avoid wrinkles around the boat. It should be drawn as tight as is possible, one or two persons drawing it out while another drives the tacks.

At the bow it is drawn around and tacked to the face of the stern, while aft it is drawn over the curved part and tacked in the same manner; at the stern it is drawn over and tacked around just inside of the sternboard, and not to the ends of the planking, as it would tend to pull them out of place. No tacks should be driven in the body of the canvas, as if it is properly stretched out it will be tight on the plank. The surplus canvas is now to be trimmed off about ¼ in. outside the line of tacks, using a sharp knife and a guide, the rows of tacks should be nicely smoothed off, as mouldings are to be fitted to cover them, which must lie smoothly.

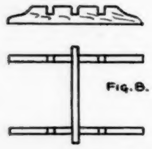


FIG. 8.

The outside should now be painted two or three coats, allowing time between for each coat to dry thoroughly; after this treatment the canvas should be firm and solid. Especial care must be taken to thoroughly fill around the tacks. The inside should now be treated with two coats of shellac, rubbing it well into the cracks. It would even be well to have given the inside a coat of shellac before bending in the frames, as then there would be no bare spots under the frames.

The stem, hull and deadwood are next to be fitted according to the plan of Fig. 6 and 7. The keel is straight, the curved piece of deadwood filling in the space between it and the boat. The stem is bent and joined to the keel as shown. The deadwood should be fitted first; the pattern may be taken from the original full size drawing, but some allowance must be made for fitting as there may have been a slight change in the shape. It must be a good fit, as otherwise it will be impossible to fasten it securely. It

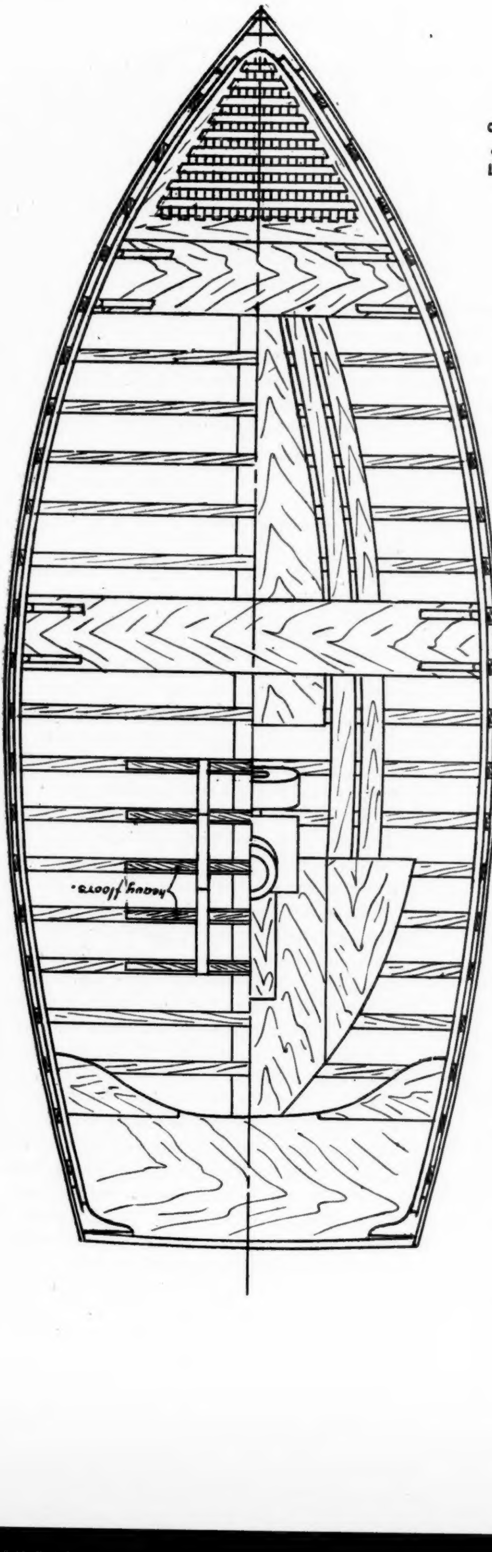


Fig. 8

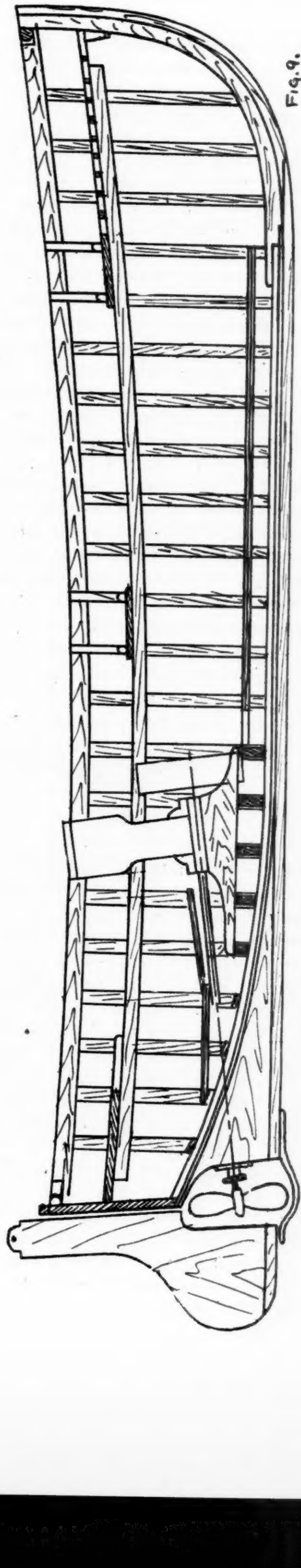
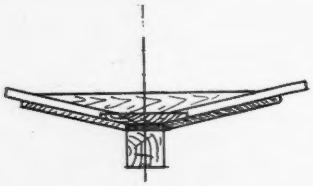


Fig. 9.

is 1½ in. thick in the small boat and 2 in. in the larger one.

Referring to Fig. 1, there will be noticed a curved dotted line at the after end of the deadwood; this is the shape for the power boat, to allow clearance for the propeller, as also shown in Fig. 6. The shaft hole would best be bored before fastening in place. It is about 1 in. in diameter; no specific directions can be given as to its direction as this will be governed by the style of engine. It is, however, 4½ in. above the base line on the other end of the deadwood. This hole must be accurately bored and, on account of its length, an extra long auger will be required.

To do this the deadwood is set up and firmly fastened in a convenient position and the boring carefully done, sighting both ways during the operation. It is well to begin boring at both ends, as any irregularity in the middle is not important and may be smoothed out by burning with a hot iron rod. It may be continued through the keel after the deadwood is fastened into place. The deadwood may now be fastened on, using brass screws driven from the inside except at the point, where a few flat head nails should be used. Each screw should be dipped in white lead before driving, as then it draws up tighter and is less likely to leak where it passes through the canvas. In the 12 ft. boat, a few screws can be driven up through the thin after end into the inner keel.



The outer keel is 1½ x 1½ in. for the small boat, and 2 x 2 in. for the large one, and in a straight length. At the forward end it runs out as shown to about ¼ in. the stem being notched down in order not to leave a feather edge. Amidships the keel is fastened by brass screws driven from inside, and aft it is screwed to the deadwood. The vertical piece on the after end of the deadwood shown in Fig. 5 is of the same thickness as the deadwood and ¾ in. deep; it is notched into the keel as shown, and extends the full depth of the stern board; its object is to stiffen the deadwood. The deadwood may be thinned down on the after end to about 1 in. thick.

The outer stem is ¾ in. thick and wide enough to cover the face of the stem. Its forward edge is tapered to ⅝ in. to receive the stem band. It is well steamed and bent to shape, allowed to cool and then fitted and fastened in place with brass screws.

The rows of tack heads must now be covered with half round mouldings; of the same material as the top streak. These mouldings are ¾ in. diameter for the tender and ⅞ in. for the launch, half round. On the stm a piece of sheet brass, or even sheet lead shoulde be bent around over the tack heads and neatly fastened.

The floor board for the tender is of ⅝ in. pine about 8 in. wide, tapered at the ends to fit the shape of the boat. It rests upon the deep floor timbers already in place, and will require to be sprung down into place. It should be fastened with screws, so as to be easily removable. Just outside of the floor board one or more strips about 3 in. wide should be fitted to give additional foot space and protect the skin of the boat. Foot braces are to be fitted for each seat similar to Fig. 8, the side pieces being ¾ in. thick and the cross pieces ¾ x1½ in. The rowlock blocks are of oak ¾ thick and 8 in. long, shaped to the curve of the side, bevelled as shown, and fastened in place with slim screws to the upper edge of gunwale and top streak. The best position for these can best be ascertained by trial. The rowlocks used should not be the socket pattern which

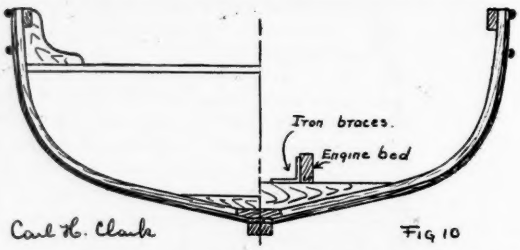


Fig 10

necessitates the cutting of a large hole in the block and gunwale, but should be of the plate pattern, fastening on the top of the block. Rubbing strips are to be fitted on the bilge to take the wear when the boat is pulled out on a float or wharf. They should be about ⅝ x 1 in. and 4 or 5 ft. long, very firmly fastened through with nails, as any movement of these strips will tear the canvas and cause a leak.

The shaft hole in the launch should be extended through the keel and smoothed out. In order to prevent the water coming in at the joint of the deadwood and hull, it is suggested that a piece of thin lead pipe be inserted in the shaft hole and the projecting ends carefully hammered out onto the surface, set in paint and tacked; this will effectively prevent any leakage from this source.

The engine bed should now be fitted; it is of 1½ in. oak, shaped as shown in Fig. 9. The exact dimensions of the engine bed must be known before building this boat. A line is struck through the center of the shaft hole and the measurements taken from the engine base laid off from it. The engine should be placed as low down in the boat as possible, the flywheel clearing the frames by two inches or more. The beds run fore aft and are placed at the proper distance apart to fit under the flanges of the bed. They should bear evenly on the cross floor timbers already fitted, and are fastened to them by screws wherever possible. Four or more angle braces should be fitted on the inside be-

tween the floors and the bed, to further stiffen it; these braces being of iron, 1 x $\frac{1}{2}$ in. with 4 in. arms. This construction should make a very strong bed and allow very little vibration.

The floor boards of the launch are of pine $\frac{5}{8}$ in. thick and should be fitted around to lie flat on the cross floor timbers. They should stop clear of the flywheel, leaving enough room for the hand, while starting the engine. They are fastened down with screws to admit of easy removal. Outside of the flat portion there are two or more strips about 3 in. wide and $\frac{5}{8}$ in. thick bent around as additional protection extending, as will be noted in Fig. 9, to just abreast the engine.

The floor in the after end is raised, as shown, to a 2 or 4 in. higher level. It must be fitted by trial to the side of the boat, a few high cross timbers of light stock being put in to hold it. The shaft will probably cut through the floor; in this case a small sloping box of wood or guard of brass can be made to cover.

The triangular space in front of the forward seat should be filled in with either a solid piece nicely fitted or preferably a grating, as shown in Fig. 8. The latter is preferable, as it looks and is much lighter. In making this grating a frame is built of pieces $2\frac{1}{2}$ in. wide. The fore and aft strips are $\frac{3}{4}$ in. square, let into the side pieces and set $\frac{3}{4}$ in. apart. The cross strips are $\frac{1}{2}$ in. wide and $\frac{1}{4}$ in. thick, let into the fore and aft strips and set $\frac{3}{4}$ in. apart. This grating sets in on the same strips which support the seat, and a small cleat is fastened on the stern to hold the forward end.

The rudders should be shaped as in the sketches, that for the small boat being $\frac{5}{8}$ in. thick, and that for the large one $\frac{7}{8}$ in. Fig. 9 shows that for the launch cut out to admit the propeller. A cleat is fastened across the bottom to prevent warping. Regulation rudder braces are used to hang the rudder, two being necessary. The skeg is of galvanized iron $1\frac{1}{2}$ x $\frac{3}{8}$ in., bent so as to clear the propeller and still close the space and prevent lines and moorings from catching on the propeller or rudder. It is fastened to the keel with galvanized iron screws. The top of the rudder is tenoned down to fit the rudder yoke.

Stem bands should be fitted of the same width as that of the face of the stem. The pattern should be chosen that has a broad flat palm to fit over top of the stem, or else the upper end of the band must be bent at a right angle to fasten over on the stem and retain the several pieces in the right position. The band should be long enough to cover the joint between the stern and the keel. A strong eye should be fastened on the inside of the stem to fasten the painter to.

Rowlocks for the large boat should be of the pattern which screws on to the side of the gunwale, no blocks being required. One pair only will be required, and they should be fitted to the forward seat.

Spruce oars should be used; for the small boat 7 ft. are best for salt water, and $7\frac{1}{2}$ ft. for fresh water; for the launch 8 ft. length is required. It is recommended that they be fitted with a joint similar to that of a fishing pole, as they should seldom be required; they should, however, always be carried.

The final painting and finishing may now be done. After the pores of the canvas are well filled with paint the surface should be rubbed lightly with sandpaper and another coat applied; this should continue until the grain of the canvas has entirely disappeared and the surface is smooth, when the finishing coat may be applied. The top streak looks very nicely if left bright, and the same applies to the inside work, if the stock is good. All bright work which has not already been so treated should have a coat of shellac and be rubbed down, afterwards putting on two coats of best spar varnish. None but the very best spar varnish should be used, as poor varnish will soon wear off and allow the wood underneath to suffer.

It must be remembered that boats of this type, while naturally strong and durable, must be well taken care of and not abused; they must be kept well painted, as lack of it will cause the canvas to wear rapidly. With proper care, however, this style of boat will last as long as any other.

The engine for the power boat should be $1\frac{1}{2}$ or 2 h. p. and should be as light weight as possible and of moderately high speed, as this type vibrates the best.

The gasoline tank should be placed under the forward grating and the pipe led either under or alongside of a floor board, where it cannot be damaged About a ten gallon tank would be advisable for this size boat. The batteries and coil should be placed in a watertight box under the middle seat; a double set of batteries should be carried.

Detailed directions for installing the motor will not be given, as they have already been given in a preceding description, and also there are individual features regarding each engine which must be considered separately. Most builders of engines give a piping diagram with the engine or would willingly do so if requested at time of purchase, and from this the detailed directions may be obtained.

EXPLODING TEST OF CARTRIDGES.

In a recent test made at the suggestion and expense of the various manufacturers of cartridges, it was demonstrated that cartridges can be burned in a fire without danger to those standing near. As the shell of the cartridge is not confined, the force of the exploding powder tears the shell open instead of throwing the bullet, and these pieces of light shell will not produce serious injuries. The cartridges explode only one at a time instead of simultaneously, so that it is a continual popping instead of a large explosion. In the test, firemen were able to work within 20 feet of where the cartridges were burning without danger or inconvenience.

AMATEUR WORK.

DRAPER PUBLISHING CO., Publishers,

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A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month for the benefit and instruction of the amateur worker.

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Single copies of back numbers, 10 cents each.

TO ADVERTISERS.

New advertisments, or changes, intended for a particular issue, must be received at this office on or before the 10th. of the previous month.

Entered at the Post Office, Boston, as second class mail matter Jan. 14, 1902.

MAY, 1906.

The competition of labor is not a new subject, yet it is so important that it can rightfully be given frequent and earnest attention. The feature now to be considered is the changes which have taken place in many manufacturing processes, whereby the opportunities for thoroughly learning a trade have virtually passed away. Even the few places which provide for apprentices, cannot give the variety of instruction once afforded—even required—of every youth. In the machinists' trade, chipping and filing, forge work, key-fitting, etc., are such a small part of the work that only a smattering of such work can be given. Special and automatic machines, jigs, etc., make much of the work so easy that a few months' experience will enable any intelligent man to earn the usual wage paid for that class of work.

This specialization of work does not mean, however, that the first-class, all-around machinist is no longer in demand, for just the reverse is the case. There is a dearth of skilled mechanics having the training and judgment necessary to properly fill such positions as foremen, superintendents, etc. The cause for this peculiar state of affairs is that the change in methods has been so rapid that the workman's side of the case has not received due attention.

It is useless to attempt a revival or extension of the old apprenticeship system. Why this is so, cannot here be stated owing to lack of space. New educational methods, which will supply the deficiencies of the shop must be supplied, and these methods must be extensive and thorough. Beginning at a comparatively early age the educational work must be progressive and practical, and in accord with actual shop methods. Completing such a course of instruction, the youth can then enter a shop with confidence that progress will be sure and rapid.

Owing to the difficulties reported by many readers in obtaining parts for induction coil-making, we are arrangeing to offer as premiums the supplies most difficult to obtain, and hope to be able to make definite announcement of the conditions in this issue. We are sure this will be greatly appreciated by all interested in coil making.

We are frequently in receipt of letters in which the wish is expressed that this magazine be issued weekly or semi-monthly. We are deeply grateful for these evidences of regard for our work, but we are inclined to doubt whether the increased cost of more frequent issues would be generally acceptable to our readers. We think the situation will be best met by increasing the size of each issue, leaving the number as at present, and we are confident, from the splendid subscription returns during the last half-year, that a substantial increase in size can be made in the Fall. If each subscriber would send us one additional subscription, the increased size would be forthcoming in short order. Let each one do his part.

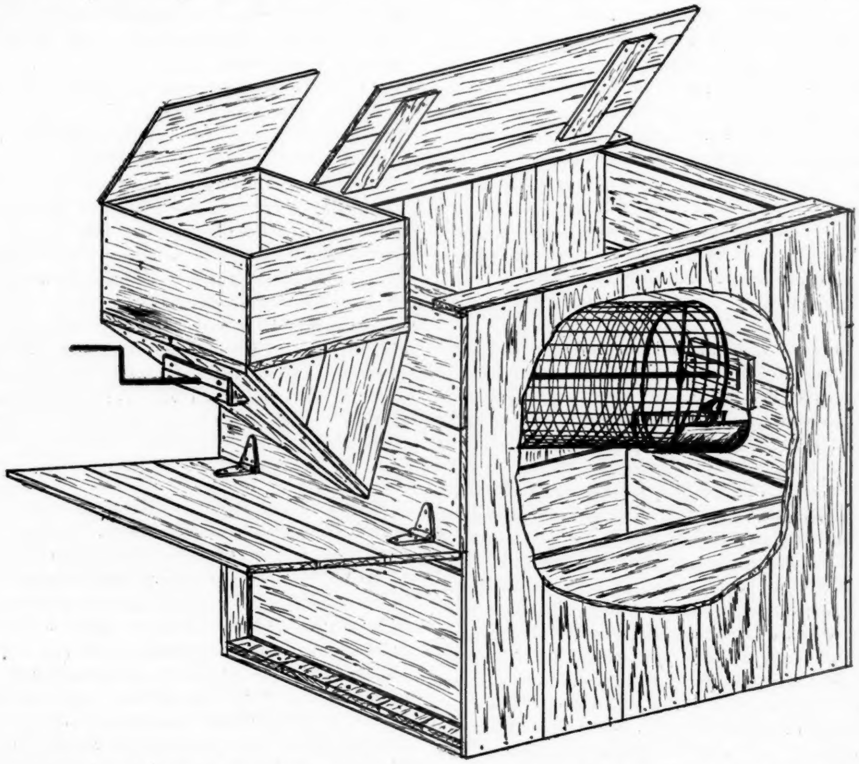
There is more iron produced than any other metal. Copper is next and lead follows. Then come zinc, tin, nickel, silver, gold, quicksilver, aluminum and platinum in their order.

COAL-ASHES SIFTER.

JOHN F. ADAMS.

This is the season of the year when the big ash pile in the corner of the cellar demands attention, and usually it is a job which is approached with reluctance, as during the work of sifting and removing it, both the worker and the cellar become liberally coated with dust. The sifting device here described is one recently made by a neighbor, and he reports that the sifting of ashes is not only a quick and easy matter, but also that very little dust can escape during the operation. but this brings the feed hopper rather high from the floor as, owing to the weight, it is not easy to lift from one barrel to another. The box arrangement shown is to be preferred.

It will be advisable to construct the screen cylinder first, and then make the dimensions of the box to conform to the screen, keeping in mind that the screen shaft is inclined at an angle of about 15° and that allowance must be made for the overhang of the screen



at the ends. With a screen 30 in. long an 15 in. diameter, this requires that the box be 33 in. long on the inside. The shaft is a piece of ½ in. cold rolled iron, 62 in. long. At the outer ends two bends of 5 in. each are made to form a crank, but the bending is not done until after the screen is finally put in place.

The illustration clearly shows the design. The unsifted ashes are placed in the hopper and the lid immediately closed. The ashes fall into the cylindrical iron screen which is turned by the crank on the end of the shelf extending through the front of the hopper. The screen is inclined at an angle of 15°, so that the turning causes the coals to run out of the lower end, where they fall into a box or hod placed to receive them.

The ashes and all bits of coal fall through the screen, which is of ½ in. mesh, into a box underneath; the box being removed when full, and the ashes emptied. The box receptacle can be replaced by the usual wooden barrel, by making the bottom into a hopper shape,

For the screen will be needed a piece of heavy wire galvanized iron screening with ½ in. mesh, 47 in. long and 30 in. wide. In cutting off, leave enough of the protruding ends to turn over the cross wire, thus preventing the joint from opening up with wear. It will also be necessary to remove one cross wire so that in making the joint the protruding ends can be turned over the cross wire of the opposite end, thus making a

firm joint. A pair of long nosed pliers will be helpful in this work, the turns then being closed up with a hammer.

It will next be necessary to fit two arms to the shaft upon which to support the screen. In the one examined by the writer these arms were made of pieces of wood 15 x 2 x ⅞ in., fitted to the shaft with a jam fit and further secured by wire nails put through small holes drilled in the shaft with a hand drill, the ends of the nails being turned over. As these pieces of wood sometimes checked the free movement of the ashes, a better way would be to use some ½ in. half round iron strips, two pieces at each end, riveting to the shaft and to each other, and turning the ends outward and curving them to the shape of the screen, to which they are secured by wiring. These arms are located 3½ and 29½ in. from the inner end of the shaft.

The wooden case is made of lumber from a large case, or several shoe cases, and obtained at much less expense than if purchased in the board at the lumber yard. The constructing of the top is shown in the illustration. The two pieces running lengthwise are 34 in. long and 4 or 5 in. wide; the two pieces at the ends 20 in. long and 5 in. wide. These are nailed together with the end pieces underneath. The bottom is made the same size and in the same way, with the exception that it is completely covered with boards running lengthwise.

The sides are then nailed on and are cut from matched boards 38 in. long. The two lower pieces of the rear end are then put on, the boards running crosswise, and the front end from the top downward, for 32 in. A door, hinged at the top, is made to cover the lower part of the front.

The top part of the hopper is a box 12 x 14 x 10 in. with a cover hinged as shown. The board at the back is only 8 in. wide, to allow the lower edge to be set 2 in. below the level of the top of the large box. The lower outside edges are beveled off with a drawknife and placed so that the pieces forming the bottom of the hopper may be securely nailed to it. The pieces forming the V part of the hopper are about 10 in. long at the longest parts, and are cut to bevels to fit the end of the box at the corners. The front side at the bottom is about 3 in. wide. When correctly fitted they are nailed to the top, and after cutting a feed hole in the front of the box, the hopper is then nailed to the box.

The feed hole just mentioned is a shallow U shape about 10 in. diameter, with the lower edge about 14 in. from the top of the screen box. The lower end of the hopper is then covered with a piece of zinc or tinned iron from a large can, having a lip which projects about 2 in. into the screen box and serving to prevent the ashes from falling between the ends of the box and screen. It is fastened in place with tinned tacks, holes being punched in the tin plate for the same with a sharpened nail.

A thrust block bearing is then made for the rear end of the screen shaft. A piece of board about 6 x 10 in. is recessed on one side to receive a small iron plate, which may be made from a piece of tire iron, or similar stock, to be had at any blacksmith shop. Holes are drilled for screws for attaching to the board. A hole about 1 in. diameter is bored in the center of the wood to receive the shaft, the end of which rests against the iron plate.

The bearings for the shaft are then made from two pieces of flat bar iron about 6 in. long, 1 in. wide and 3-16 in. thick. They are laid side by side and a small circle laid out at the center of the joint. The circle is filed out with a round file, keeping in mind that the shaft is at an angle of 15° and the hole between the pieces must coincide. The hole is made slightly less than the diameter of the shaft, so that the wear can be taken up by moving the plates together as they wear. Similar plates are made for the front end bearings, but owing to the angle of the hopper front, it will be necessary to receive the plates. A 1-in. hole is bored through the front of the hopper at an angle to receive the screen shaft.

The screen is then put into place through the opening left at the rear, this opening is boarded up, covers made for the top of the case and hopper and lower part of the front. A box is made to receive the ashes and placed in the space under the screen, and the sifter is then ready for duty.

The pupils in manual training schools who wish to convince their parents that the instruction they are receiving is of some "practical" value, will find this sifter, if well made, an excellent illustration in that respect.

Bismuth is a hard, brittle metal, with a reddish-white color and metallic luster. It looks much like antimony, but is readily distingushed from the latter by its reddish tinge of color. When heated to redness it burns with a bluish flame, forming the yellow oxide of bismuth. It is not very abundant in nature. The most important ores of bismuth are the oxide and sulphide. Its chief use is in pharmacy, and the metal must be free from impurities, particularly arsenic. Bismuth ores are roasted, after which various methods of treatment are employed, according to the ore. When arsenic is present the last traces of it may be removed by melting the metal with niter. Hydrochloric acid has little effect on metallic bismuth; strong sulphuric acid forms bismuth sulphate, and when treated with nitric acid bismuth acid results. Bismuth is not known to form any combinations with hydrogen.

Among the uses that borax is put to are: In the manufacture of porcelain-coated ironware known as granite ware; in pottery and earthenware as a glaze; in the manufacture of paste used in glasses and enamels; in artificial gems, etc.

SPECULUM GRINDING AND POLISHING.

J. R. STEPHENS.

I certainly advise anyone interested in this subject, or in photographic astronomy past and present, to read the memoirs of Dr. Draper (date 1864) and Prof. Ritchey (date 1904). They are bound together in "Smithsonian Contribution to Knowledge," Vol. 34, and may be ordered though any bookseller. They cost together 75 cents. The address is Smithsonian Institution, Washington, D. C. To throw more light on what has gone before, I will make a few short abstracts from Prof. Ritchey's book. They are as follows:

"No greater mistake could be made than to assume that cheap and poorly annealed discs of glass, or those with large striæ or pouring marks, are good enough for mirrors of reflecting telescopes."

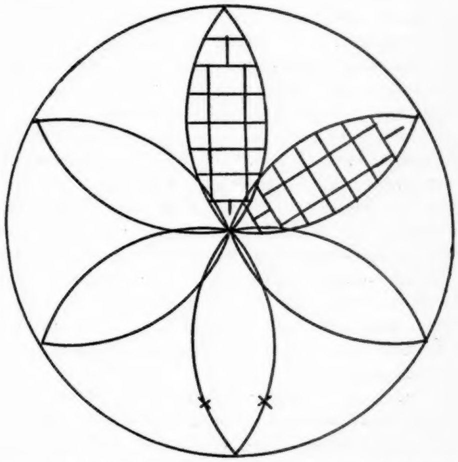
"The thinner mirrors suffer much greater temporary change of curvature from the very slight heat generated during the process of polishing, and they are undoubtedly more likely to suffer temporary disturbance of figure from changes of temperature when in use in the telescope."

"All mirrors should be polished, not figured, and silvered on the back, as well as the face, in order that both sides may be similarly affected by temperature changes when in use in the telescope. For the same reason the method of supporting the mirror should be such that the back is as freely exposed to the air as possible.

"Half-size tools, 8-15 of the diameter of the mirror are economical, and are quickly prepared, and a much greater variety of stroke can be used with them, so that, with a well-designed grinding machine, I have found it easier to produce fine-ground surfaces, entirely free from zones, with half size, than with full-size tools. If temperature conditions and uniform rotation of the glass are carefully attended to, the surface of revolution produced by the smaller tools is fully as perfect as that given by the larger ones."

Grinding-tools for concave and convex mirrors are always made in pairs, one concave the other convex. These iron tools, when being cast, are poured face down, so that the face will be clean. They are turned in a lathe, to the proper curvature as shown by templets. The convex tool then has grooves cut across its surface in a planer. The tools are then ground together with the fine grades of carborendum, which is much more effective for this purpose than emery, and water. This enables the optician to secure the exact curvature desired. A very important point is that by grinding with the concave tool on the top, the radii curvature of both tools can be gradually shortened. When the convex too! is used on top, the curvature of both is gradually flattened. By this means, and the use of very fine grades of carborundum, a most perfect control of the curvature of the tools may be had."

Prof. Ritchey does not use carborundum in grinding the mirror.



"Before beginning the fine-grinding of the face and back, it is well to round the corners at the edge of the glass. This is done by means of a smooth flat strip of sheet brass of the size and shape of a large flat file. This is worked over the corners of the glass by hand while the disc rotates slowly, emery and water being used for cutting. A quarter-round corner is usually made. Finer and finer grades of emery are used for smoothing the quarter-round. This rounding and smoothing are very necessary, as particles of glass from a sharp or rough edge are liable to be drawn in upon the surface during fine-grinding."

The grades of washed flour emery used for grinding are 2, 5, 12, 30, 60, 120 and 240 minutes. "A weight of grinding-tool on the mirror of ½-pound per square inch is not objectionable with emeries down to 5 or 10 min. washed. With 30 min. washed, and all finer grades, scratches are almost certain to occur with this pressure. The pressure on the glass is therefore decreased by counterpoising the tool to ⅓ pound per square inch for 12 to 20 min. emeries; ⅛ pound per square inch for 30 to 60 min. emeries; and about 1-12 pound per square inch for 120 and 240 min. emeries. This obviates to a great extent the danger of scratches in grinding, provided that thorough cleanliness is practised on the preparation and use of fine emeries."

After the rosin squares are stuck to the polisher and warm pressed to shape on the mirror and redressed

with a knife, they are ready for coating with wax. "A pound of best beeswax is melted in a large clean cup, and is very carefully strained through several thicknesses of cheesecloth, into a similar clean cup. A brush is made by tying several thicknesses of cheesecloth around the end of a thin blade of wood 1¼ in. wide, the width of the squares. Each rosin square is now coated with a thin layer of wax by a single stroke of the brush. The wax should be very hot—otherwise the layer will be too thick." The polisher is then cold pressed.

"The thin cream of rouge and water is applied to the glass by means of a wide brush, consisting of a thin paddle of wood, with thin cheesecloth wrapped and tied about one end. Brushes of the usual kind should not be used.

By taking these precautions and by the use of the wax surface on the rosin squares, scratches in polishing can be entirely avoided. The wax surface polishes more slowly than a bare rosin one; but it has the very great advantage that its action is more smooth and uniform. The rosin surface often tends to cling to the glass, and this unequally in different parts of the stroke.

When the bare rosin begins to show at the corners or edges of the faces of the squares, which will occur after six or eight hours' use of the tool, a new coat of wax must be applied and the tool again thoroughly cold pressed."

"Weight of polisher for large tools, 1-18 pound for each square inch of area, which is found to work well for all large tools. For tools 18 in. or less in diameter, somewhat greater pressure per square inch may be used."

"My practice has been to fine-grind and polish to a spherical surface free from zones, and then to parabolize by means of suitable polishing tools."

"On account of the ease of rigorously testing a concave spherical surface, this is the form which should be first attempted by beginners in optical work."

"The tendency of the edge to turn back or down is most pronounced when a long stroke is used to excess, or when the rosin squares are too soft. It is entirely prevented by rounding the extreme outside squares, all around the polisher, in something like a semicircular form, convex to the edge of the polisher."

Changing a Spherical Surface to a Paraboloid.—This is accomplished by shortening the radii of curvature of all the inner zones of the surface, leaving the outermost zone unchanged. There are two distinct methods of accomplishing this. First, by the use of full-sized polishing tools, the rosin surfaces of which are cut away in such a manner as to give a large excess of polishing surface near the central parts of the tool. Second, by the use of small polishing and figuring tools, worked chiefly upon the central parts of the mirror, and less and less upon the zones towards the edge."

The details of second method have already been given in the extract from Dr. Draper; but Prof. Ritchie further notes, that the squares around the edges of the small tools should be trimmed semicircular, as before described, in order to soften the action of the edge."

"Parabolizing with Full-size Tools.—The rosin surface can be trimmed in a variety of ways to give a great excess of action on the central parts of the mirror. The figure (scale 1 in. to 1 ft.) shows one of the best forms of tool for this purpose, six leaf. The small crosses indicate the centers from which the sides of the leaves are struck. The leaves are rosin, coated with wax. The grooves are made as shown, alternate leaves being alike, thus balancing the tool surface. The form of the edges of the rosin-covered areas can be altered, and thus the amount of action on any zone can be in some measure controlled. Length of stroke and amount of side throw are also very important factors in controlling the figure of the mirror. Tools of this kind serve admirably in parabolizing mirrors up to 36 or 40 in. in diameter, when an angular aperture is not very great."

"Small local tools, of the six-leaf form, are also excellent for polishing out zones."

"The use of an eye-piece in this test (one of Prof. Ritchey's spiral tests) is important, because it shows how fatal to good definition is even very slight convexity or concavity of a plane mirror, when used in oblique positions."

"The reflecting telescope defines well only at or near the optical axis; hence the mirrors must remain in perfect adjustment with reference to each other and to the eyepiece."

"Testing a Paraboloid on a Star.—With this method the mirror surface, as seen with the knife edge test, presents the same general appearance as in testing in conjunction with a large plane mirror. In testing on a star it is seldom indeed that the atmospheric conditions are sufficiently fine to allow any except the larger errors of surface to be seen."

And so on. In fact, I think that the two memoirs taken together, are most complete.

A new development in electric welding is the automatic production of continuous rolls of wire fencing, says the "Iron Age." A number of galvanized wires are fed from reels arranged vertically and parallel to each other, and from another reel placed transversely to these are cut off lengths of wire, which are fed horizontally across the vertical wires. Where the horizontal and vertical wires intersect, these are welded together by means of small transformers. The welded section then moves forward a predetermined distance, and the operation is repeated.

"It is easier to attend to another man's business than it is our own."

HOW TO MAKE CUTS FOR PRINTING.

J. BUTLER HAVILAND.

Every printer, publisher and large advertiser knows that good illustrations are not only necessary but expensive, especially when they are made by an engraver. But by the simple etching and transferring process herewith described, anyone with ordinary intelligence can, with but little practice and a very simple outfit, make first-class cuts from prints and pencil or ink drawings at trifling cost.

Lithotint cuts are the easiest and quickest made, and the operation is as follows:

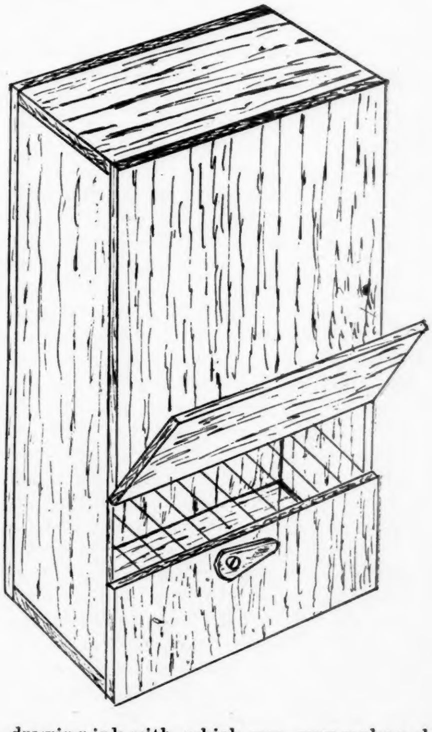
For the surface of the plates common sheet zinc is used, about 1-16 in. thick, but a thicker gauge may be used. Engravers' zinc can be purchased in most of the larger cities at but little higher cost than for common zinc, and is well worth the extra cost, as it has a much smoother surface.

Cut the zinc into strips of different widths, and with tinner's shear cut these strips into proper lengths as needed, always cutting the pieces a little larger than the size required for the sketch or transfer. Scour one side well with pulverized pumice stone or flour emery and a wet rag; rinse and dry and be careful to avoid grease spots.

Ordinary magazine prints, pencil or india ink drawings are thus transferred to the polished surface: Saturate the paper in a solution of 1 part nitric acid to 8 parts water in an etching vessel, which may be an ordinary glass developing tray, such as is used in photography; then lay the saturated sheet between other sheets of soft paper, and by rubbing lightly with the hand over the top sheet, absorb the surplus fluid, but avoid getting the print too dry. Before getting the drawing or print ready for transfer, have an electrotype of sufficient size, with level wood base, locked in center of printing press chase, with wood side up; take impression on tympan to get location, and set pins close to lower edge of impression. There should be 18 or 20 sheets of newspaper under the tympan, and the heavier the impression the better the transfer.

In the absence of a press a workable impression may be taken by placing the sheet of zinc on a smooth table top, with the drawing face downwards on it, and press the two into close contact with a hard rubber roller, such as is used for mounting photos. In taking a hard press transfer, place the wet sheet on the tympan in the desired location, after which the zinc is placed over it, bright side down, supported at the lower edge by the gauge pins. Now take a heavy impression, allowing the pressure to remain on for a few seconds. The fiber adhering to the zinc is rubbed off with soft paper; rubbing a pencil transfer improves it, but don't rub a transfer from a print much.

In transferring cuts printed with the finer inks, saturate in caustic potash dissolved in two to four times its weight of alcohol, pour a few drops on the print and flow it over the whole surface, then wash the paper in weak acid solution, as before directed, blot and quickly apply to zinc with pressure. Pressure can also be obtained under clamp of paper cutter, in an ordinary copying press; lay zinc on a level block and place 20 sheets of newspaper over all.



A drawing ink with which you may make a sketch on zinc, or trace the lines of a transfer from a dry print, pencil or india ink drawing, is made by thinning black printing ink with oil of wintergreen or oil of sassafras to a consistency that will barely flow from a smooth pointed Spencerian pen. Mix in a small tin box and take the ink only on the point of the pen, each time touching another piece of zinc with the pen before continuing the tracing, which prevents an overflow of ink when the pen comes in contact with the work.

In ruling lines, elevate the rule slightly when crossing lines. When you desire to erase, first dust the whole plate with dragon's blood—as hereafter de-

scribed—then erase with the point of a penknife. When the tracing is done the next operation is powdering the plate.

In a cigar or other tight box have two or three ounces of finely powdered dragon's blood. Shove one end of the plate under the powder and manipulate so that the powder will slide over the plate two or three times, that the lines may catch and take up all they will hold. Now jar off the loose powder and sweep well across the plate in all directions with a soft camel's hair brush, which leaves the lines as clear cut as before the powder was applied.

Next comes the tinted ground. This is made by rosin dust settling evenly on the plate. You can do this with a box, as shown in the cut. Make a tight box about 24 in. high, 6 in. wide and 8 in. deep. Hinge a 2 in. door across the front 4 to 6 in. from the bottom and flush with the bottom of the door, stretch three or four light wires through the box from front to rear. Next make a wooden slide that will slip into the box loosely; the wires are to support this slide, on which the zinc lies while the rosin dust is settling. Have three or four ounces of rosin well powdered in a mortar so there will be considerable dust in the mass, mix well in this three or four tablespoonfuls of lampblack, then put the mixture in the box. Have the plate ready on the slide outside the box, and with the door closed, turn the box so as to let the rosin mass fall suddenly from one side to the other. Then open the door, insert the slide and close it again; in ten or fifteen seconds draw out the slide and notice the deposit of dust on the plate.

If you think there is not a sufficient deposit, repeat the operation. If the dust deposit is too heavy, blow it off entirely, shake up the box and try it over again. A comparatively heavy deposit will admit of much deeper etching than a light one, but you can get it too heavy or too light, and it will require some experimenting to determine the deposit a plate should have. With a suitable deposit of dust, carefully and evenly heat the plate, back down, till the red lines of the sketch turn black and the fuzzy looking deposit seemingly disappears. The heat fuses the ink and the powder together and melts the particles of rosin.

Next spread a coat of thin asphaltum varnish on the back of the plate and varnish a quarter of an inch around the face edge of the plate; hold plate close to heat a few moments, and as it cools it will dry rapidly. Thin the varnish, when too thick, with turpentine. Shellac varnish is good substitute, but it takes alcohol to cut it off the plate.

Next comes the etching. In the glass developing tray pour enough of a mixture of about nine parts water and 1 part nitric acid to flow over the plate, when the vessel is raised and lowered at one end. Then lay the plate in, face up, and wash the solution back and forth, as indicated. After operating this a few minutes, take cut out and rinse in clean water and examine the groundwork; an ordinary magnifying glass will assist the examination. As long as the little elevations are not beginning to thin out in little patches, you can continue the etching. The etching exhausts the acid, and by adding to the bath a little full strength acid after a few minutes etching, the work may be hastened. When a slight simmering cannnot be heard on the plate when the ear is held close, it is safe to add a little more acid, but never quite as much as it originally contained.

Take the cut out when adding more acid and thoroughly mix before replacing the plate. If the bath is too strong, creating a froth, it is liable to ruin the plate unless it is instantly removed and more water added. The character of the tinted ground depends on the amount of rosin deposit and the depth of the etching. When the etching is finished pour a few drops of alcohol on the line work and rub it with the fingers, which removes the composition; then clean both sides of the plate with benzine, after which cut the plate to size required, removing all traces of grease from back with lye, saw a block base from ⅞ in. wood to size of cut and level the face of it with a sand paper block. The plate is then fastened to the wood base with small brads, first punching holes for same in the plate with a sharp pointed punch in places where the plate has been etched. The best impressions of lithotint cuts are on smooth finished paper.

PLAIN LINE CUTS.

To make plain line cuts, follow the foregoing instructions to the point where the plate is first placed in the acid bath omitting the rosin dust. Go through the same manipulation until you get a depth of about one quarter the thickness of the zinc plate.

Now the sides of the lines will need protection. As the plate lies in the bath remove the dissolved zinc from it with a camel hair brush. Occasional brushing in like manner is advantageous all through the etching process. Then quickly rinse the plate in water, dry, remove composition from lines with alcohol and clean plate free from grease with lye. With a roller put a smooth medium coat of job ink on a smooth, solid, heavy cardboard, lay it on a perfectly level surface, then lay the cut face down on the inked surface of the card and with a rolling pin, or something equally round and true, roll with considerable pressure across the plate in different directions until you see by examination that the faces of all the lines have taken ink; then apply the dragon's blood and in removing the loose powder that is not held by the ink, brush gently both ways across the plate, and both ways from end to end, until all is swept from the etched surface.

Between the lines that are close together the powder will remain, as it ought if you brush gently, for further etching is not necessary at such points. Now heat the plate well until the powder and ink fuses and you see a little smoke rising from the plate; the heat causes the fusing composition to flow down the sides of the lines which protect them. When the

plate has cooled, in spots where the ink has caught in any of the open etched places, scratch it out with a sharp pointed penknife, then varnish the back of the plate and continue etching. When the dark coating on the plate can not be removed with a gentle touch of the brush, it is safe to add a little more acid to the bath; and when the bath gets thick and slimy it is best to throw it away and use fresh.

This time go about half through the zinc, then clean the cardboard, apply the dragon's blood and heat plate as before; then varnish the back and proceed to etch again until there is but a thin shell left. Next, clean both sides of the plate and trim up to about ⅛ in. of the part occupied by the line work and mount on a block. When mounted, cut out with the point of knife all open places as large as the end of your thumb and larger.

To make a plate from a type form, take a fresh, well inked impression on smooth paper, saturate paper in water, drain the water off and transfer by pressure to cleaned zinc, same as in making other transfers. Give the transfer the dragon's blood treatment, next the rosin dust, then heat the plate and proceed to etch the same as in making a lithotint cut. Fresh impressions from cuts can also be transferred and etched in this manner.

GENERAL INFORMATION.

A lithotint cut can be given a second and deeper etching by the re-inking process. When a design for a cut is not well covered with line work, the plate should be made in the lithotint style which, like a half-tone is solid printing surface, there being no white or open spaces to cut out. During the progress of the etching if you notice any weak point that is liable to cut away, dry the plates; with pencil, brush and asphaltum varnish, carefully touch it up, dry a little and continue etching.

To make a cut from a photo, draw with India ink right over the outlines of the photo outlines, dry, and proceed as with an ordinary drawing. Dragon's blood is preparation of rosin nature, which may be purchased at any druggist's.

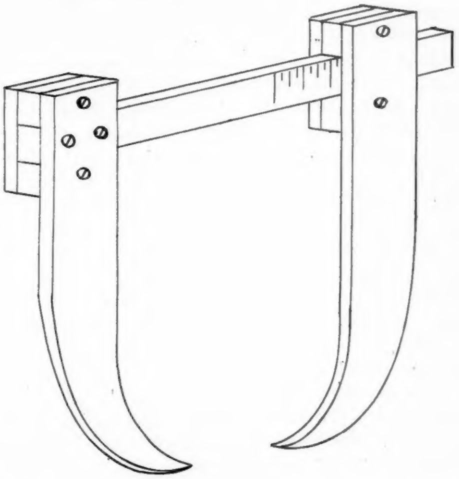
THICKNESS CALIPER.

CHARLES E. BURROUGHS.

The amateur boat builder, in working out a wooden hull, is frequently in a quandary as to the thickness of wood remaining at some particular place; he hesitates to make a cut fearing the gouge or chisel may go through, and yet desires to remove all the wood he can to get a light boat.

This is especially true of model steamers where the weight of the machine is generally so great as to necessitate the very light hull, to avoid too great a displacement. In pattern making similar difficulties are often encountered. In such cases a thickness caliper, like the one here described will be of great assistance, as the thickness of wood or metal can be very closely ascertained without trouble. The shape of the legs can be varied to meet the needs of the work, the principal requirements being stiffness and a close fitting joint between the sliding leg and the bar.

The bar should be a piece of well seasoned, straight grained maple. A piece of "reglet," obtainable from about any printer is suitable, as it is finished in oil. For a small boat a piece 12 or 15 in. long will answer, together with four pieces 1½ in. long.



If only approximate measurements are needed, the legs can be made of four pieces of a cigar box, which are cut out to the shape shown, and of a size to clear any projections on the work. Additional square pieces are needed for closing up the back. When cut out, the legs for one end are fastened together and to the bar with glue and small wood screws.

The sliding bar is put together in the same way, excepting that pieces of thin cardboard are put between the blocks and the piece at the back, which serve to give the necessary play so that this leg may slide freely, but not loosely. The two blocks above and below the bar should be spaced square with the bar and with only sufficient allowance to slide without binding.

After completing the two legs and mounting on the bar, the tips of the legs are brought together, and a mark made on one side or top of the bar with a knife. The sliding bar is then removed and a scale laid out, the divisions being made with the point of a knife and the marks filled in with India ink. If a very accurate reading caliper is desired, the legs should be made of brass; in fact, the whole tool may be made of that metal, in which case the joints are brazed. A combination tool can be made by slots in the two boxes on the bar and several sets of legs can be made, which are held in place by set screws. For general purposes, however, several different sizes made of wood will answer.

ELECTRICAL CONDENSERS.

OSCAR F. DAME.

There are two types of condensers which date back to the earliest days of electricity, before Franklin's time, when the only known electrical generators were the statistical machine and the electrophorus. These two types were the Leyden jar and the glass plate substitute for the Leyden jar.

The Leyden jar was used in connection with cylinder and plate static machines to gather the electricity collected by the "brushes" and hold the charge to the maximum capacity of the jar, when the discharge would take place disruptively and with great volume of sound. These jars were made of thin clear glass, similar to the ones in use today in all laboratories, with both inside and outside coated with tinfoil to one-half or two-thirds the entire height. The capacity of each jar in micro-farads was infinitely small, the average being roughly estimated at about .0005 M. F.

Consideringcapacity in micro-farads, as we speak of it in connection with induction coil and telephone and telegraph practices of today, it would necessitate thousands of such jars to equal in capacity the modern type of small condensers which can be slipped into one's pocket with ease. There is a scientfic reason for this, which should be understood by the amateur worker, because of the value of the information in wireless telegraphy as well as in other pursuits. Three things enter into the calculation of capacity:—The area of the thin metals we utilize for the purpose; the distance we separate these surfaces one from the other, that is to say, how far apart they are separated either in dry air, in oil or by means of an insulating substance like glass, mica, hard rubber, paraffined paper or the like; and thirdly, the value of this intervening substance as a dielectric or insulator.

We might take the best of metals, such as thin lead or tin-foil, and separate the sheets with poor, unwaxed paper, and get a very faulty condenser. We might use poor mica, full of pin-holes or flaws, or hardsheet rubber with metal specks in it, all of which would in time render the condenser worthless. In the selection of the insulating material we have two standards, oil and mica, the former the best liquid medium, and the latter the best solid. For oils, we have kerosene, paraffine oil, transel oil, linseed oil, etc.; for mica we have all grades at all prices, the best grades being very costly. Mica is not obtainable in very large pieces, the average commercial sizes seldom being over 6 in. square. Consequently mica condensers must be for very small capacities or built up of many layers. All the highest priced testing apparatus used in laboratory work have mica condensers, and many of them are silvered similar to mirrors instead of being coated with thin metal sheeting. For general purposes glass would answer, but is not procurable in sufficiently thin pieces.

As was before mentioned, the distance between opposite faces regulates the capacity. The sheets of metal of certain size, separated 1-64 in. apart, give just twice the capacity when separated 1-128 in. Then, again, if the material used in separating them was paraffine paper of ordinary quality, we could not expect so great a capacity, to use a shellac coating between, which in some cases improves the capacity co-efficient. The co-efficient of inductive capacity is not as much considered in modern practice as it should be. Nowadays many foreign made induction coils are equipped with thin, poorly waxed paper dielectrics, which will hardly stand the strain of a primary core discharge of not over 20 volts.

This weakness demonstrates itself in the tiny thread like sparks from the secondary; the charge which should have returned to the primary winding short-circuiting itself in the condenser dielectric. High-grade condensers for coil work are made in two ways. In those of foreign make it is the usual custom to cut the foil and paper in small squares and connect the metal sheets alternately to common terminals, that is to say, 1, 3, 5, 7, and so on, form one terminal, and 2, 4, 6 and 8 the other. In ordinary condenser work in this country it is customary to arrange the condenser materials in long, narrow strips, the paper and foils being on rolls in such position that two sheets of very thin bond paper with a strip of foil between, will pass through a sort of clothes wringer attachment, through paraffine wax, and emerge stuck together as one. Such a strip forms a completely insulated side for a condenser, and two of these sheets about 5 in. wide and several yards long, may be laid one on the other and folded or rolled into desired shape.

There is one disadvantage about such a condenser, however, which has been overlooked by most American coil makers, and that is the "unloading value" of a condenser. Disregarding all that has been written about condenser theories, every man knows, whether electrician or not, that the more of the tail board of a wagon taken out, the quicker the load may be dumped. Now, when a condenser is made of two long, insulated strips of foil, flattened or rolled into shape, such a condenser is sluggish. It does not unload quickly. The charge stored within it leaks out through a sort of resistance which dissipates the quantity of electricity the condenser was calculated to hold and release. The reason these condensers are made this way is because of simplicity and cheapness of

construction. Competition requires a minimum of expense and labor in all departments of coil manufacture, and in this type of construction there is a saving of fully 20 minutes work on each coil.

The latest type of condenser, however, is made up of two strips of the thin bond paper, as before described, and the roll of tinfoil between, but the foil instead of being narrow and hardly reaching within one inch of the paper's edge for the sake of insulation, projects on one side a full inch. In rolling up such a condenser, two of these strips are placed so that the foil of No. 1 projects on the opposite side from that of the No. 2. The sheets are then rolled in flat form and the foil projecting from the first side crimped together for one terminal of the condenser, and the other side pressed or crimped for the other terminal. Such a condenser will "unload" with a rush. When used on gas-engine coils having vibrators going at the rate of 1200 a minute, this condenser demonstrates its peculiar fitness for the work by giving a very lively and flaming secondary spark. Even on wireless telegraph coils the spark value is increased one-quarter by its use.

The purpose of the condenser as regards the induction coil is two-fold, it being used primarily to absorb the spark caused by the breaking of the primary circuit at the vibrator contact points. The second and more important value of the condenser is its intensifying power whereby the extra discharge from the primary circuit is held in store and at the proper time released into the primary circuit again. The value of the condenser in this second case is readily appreciated by disconnecting the condenser from any coil, and noting the depreciation in the secondary spark discharge. As a matter of fact, a 1-in. spark coil will hardly spark at all, with the condenser removed.

The question now arises: With given primary core and winding specifications and a vibrator operating a stated number of times per minute, by what formula or method is the proper capacity for the condenser calculated? Here is an instance where experience counts more than mathematics. Coil manufacturers, as a rule, have stock specifications for use with all kinds of coils, but it is true that some one had to figure out all the details carefully in the first place.

Let us consider the iron core of the coil. There are all grades of iron and steel wire used in the coil manufacture. The best wire is Swedish iron wire. This comes in all wire gauges. The finer the wire used the better the operation of the coil. In moter and dynamo construction we learn the value of laminated armatures. We find that all solid masses of iron are avoided. The thinnest discs of soft iron are bolted together to form a laminated armature so that the losses by hysteresis may be at a minimum. In such a small affair as an induction coil, the difference in results between a steel wire core and a Swedish iron core would seem so trifling as not to warrant the extra cost of several cents per pound for the iron wire. In the cheaper grades of coils, particularly in automobile coils manufactured by the thousands at a very low wholesale price, the finer details of core construction are not considered. It is purely a problem of getting a minimum cost for all materials and turning out something that will do the work and beat the other fellow out of the market. In such coils we find single cotton covered wire primaries, with no insulation between layers, and No. 20 gauge soft steel wire cores. If such unscientific construction was put into a watch or dynamo the manufacturer would soon have to mend his ways or go out of business.

It will be found that the more perfect the core, the easier it will be to provide a condenser to work in harmony with the primary winding. The more turns of wire about the iron core for the primary, the greater the magnetic effect of the core; subject to certain limitations.

The more turns in the primary the greater the spark at the contact points before the condenser is installed. Sufficient turns have to be made on the primary to make the core powerful enough to attract the hammer head of the vibrator. In building a coil, therefore, where the spark is to be not over one inch in length in the open—for automobile purposes, for example—it is advisable to put just as few turns of No. 16 or 18 waxed double covered wire over the core for a primary as will magnetize that core, (when the proper amount of battery is used) and attract the vibrator hammer head. The larger its area exposed to the end of the core and the shorter the vibrator stroke, the faster and fatter will be the secondary discharge.

It was once the custom in small coil manufacture to wind on four or more layers of No. 13 wire for the primary in the belief that the added resistance of 4 layers in preference to two of larger cross section would reduce the current consumption one-half and prolong the life of the batteries accordingly. Coil manufacturers have since found by experience what every electrician has long known to be a fact, that the proper way to get around the sparking at the platinum points was not through the increase of condenser capacity, but by reducing the number of turns on the primary as much as possible. It was found that a vibrator could not be constructed too speedy to fail to give a secondary discharge, and also that a fast vibrator did not require anwhere near the condenser capacity as a slower vibrator.

It was also found that a fast vibrator, working through a low inductive winding, was just as easy on the battery as the slower vibrator and the many-layered primary winding. Also, the wear on the platinum points was less. Based on the cost of platinum, as in comparison with the cost of batteries, the fast vibrator and low winding would prove more economical even if the batteries did become exhausted more rapidly than in the previous case.

The cost of constructing a condenser for the latter coil is much less than that of the former, owing to the less amount of tinfoil and waxed paper required. Sum-

ming up the cost in each case, we find that there is a saving in the primary wire of just one-half, (which permits the use of the best grade of core wire), a saving in cost of vibrator materials, and a saving in condenser cost.

With larger induction coils, giving two or more inches spark, we have much more wire on the secondary than in the one inch coils. This mass of copper wire is practically a shield of copper over and about the primary core and winding, and it is impossible to use a vibrator intended for a 1-inch coil on this larger coil and get maximum results.

The vibrator, if core-operated, must be much slower to allow a more complete saturation of the core, and the condenser will have to be correspondingly increased in capacity to handle the spark at the make and break.

The construction of a condenser for a coil will furnish the best lessons in the work—far better than any mathematical formulæ to be had at the present time. Any one undertaking this task, should make provisions for increasing or decreasing the capacity as needed until the proper size is ascertained, by making the condenser in sections.

SPEED OF THE STARS.

One of the most remarkable features of the universe is that every so-called fixed star is moving forward on an undeviating path which, so far as we can yet determine, is a straight line. Nothing is better calculated to give us an idea of the extent of the universe than the contrast between the speeds as we observe them from the earth. The actual speed is enormous when compared with any that we can produce by artificial means. The speed of a shot from the most powerful gun can scarcely, if at all, exceed half a mile per second. But if the motion of any star is as slow as one mile a second, it is only in very rare and extraordinary cases.

The average speed of the stars is about 20 miles a second; and this motion, it must be remembered, is not, so far as determined, motion round and round in an orbit, but a straight ahead motion, never relaxing and never swerving. Almost every star, therefore, travels hundreds of millions of miles every year, century after century. And yet so slow do the motions appear to us that the naked eye can see no change in the configuration of the constellations during a period of thousands of years.

A remarkable instance of this kind is afforded by "Arcturus," which is, so far as we know, one of the swiftest moving stars in the heavens. It seems quite certain that its speed exceeds a hundred miles each second of time and it may be much greater. And yet if Job could come again to life and study the constellation Bootis, in which Arcturus is situated, he would scarcely notice any change in its appearance. There is not a star in the constellation Orion moving so fast that any change would be noticed by the naked eye in 100,000 year. Every star in the heavens appears in the same position when observed night after night. There are very few in which the astronomer can detect any motion by one year of observations.

Accurate determinations of position commenced with the observations of Bradley in the eigthteenth century who determined the position of more than 3000 of the brighter stars. Since his time the position of several hundred thousand stars have been accurately fixed. Yet so small is the apparent proper motion in most cases that it has been actually detected in the case of only a few thousand stars. Even now there are scarcely a hundred stars of which the motions are known to exceed one second in a year. To understand what this means we must reflect that it would take a good eye to see that two stars in the sky, 200 seconds apart, were not a single object.

Had it not been for the great precision of the telescopic determination, astronomers would not have known to this day that any star in the heavens had moved from the place which it occupied in the time of Ptolmy, 1800 years ago. The star, Z. C. 5243, if it were to continue its course round the sky without ever stopping, would take more than 140,000 years to make the circuit of the heavens and the actual speed of this star is known to be about 100 miles per second.—"The Mining World."

"Our local newspaper had its lynx eye on a smoky chimney that belonged to an ex-mayor of the town. It held that public men should not be producers of public nuisances.

I called to see my friend, the ex-mayor, and he said, 'Look, here, they are at it again and now they threatening prosecution.' He told me what he had done to prevent smoke pollution. He had put in patent stokers, steam jets to aid the draft, a new sort of patent grate bars, raised the chimney 25 ft. and had used a better class of coal, and he said 'What more can I do?' He was a busy man and was glad when I offered to go to his works to see if I could suggest anything that could be done.

So much depends on the fireman that we came to the conclusion that it must be all his fault. I found, however, that the two boilers which had been quite sufficient for the works as originally planned were not so now a large dye house had been added and was in full blast.

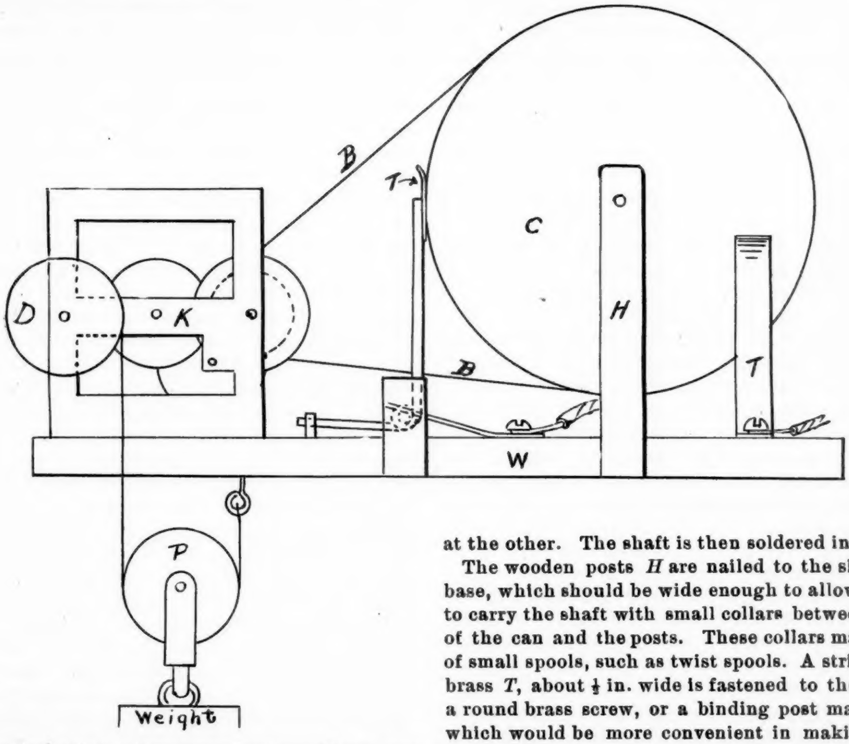
I suggested that a 32-inch Sturtevant fan be put in at the root of the chimney—this fan to work at a varying speed to suit the demand for steam. A fan was put in and it ended the trouble, no more complaints about black smoke, plenty of steam for all purposes, the quantity and quality of the work was improved, and all at a comparatively small cost, which was soon repaid by less coal consumption."—"Engineer."

MECHANICAL TELEGRAPH CALLING DEVICE.

HAROLD P. DAVIS.

The amateur telegrapher working on a line connecting the residences of one or two friends, has undoubtly wished many times that he had some device which would enable him to repeat the "call" for several minutes at a time and so avoid being obliged to do so by hand. Repeating the same letters from ten to thirty minutes at a time becomes both monotonous and tiresome, and when the operator at the other station is busy with other matter this is sometimes necessary.

The can should have one inch of depth for each "call" to be made, and an equal space for the belt. Measure off the can and cut to the required depth with tinner's snips, using care to avoid dents in the cutting. The cover is then put on and lightly soldered in place. Locate the exact center of each end and punch holes for the shaft, which may be cut from a piece of brass rod, as used for sash curtains. The shaft is cut to a length to project ½ in. at one end and 1 in.



The repeater which is here described provides a way for calling an office mechanically, and will run long enough with one winding of the weight to "raise" the desired office if the operator there visits the room at all frequently. It is easily made from materials to be found in about every household, or any parts lacking can be obtained with but little trouble. The requirements are: The movement from an old clock, a double and single pulley as used for awnings, a clean tin can as used for coffee, some strip brass and brass rods and wood for a base and posts, as will be described.

at the other. The shaft is then soldered in place.

The wooden posts *H* are nailed to the sides of the base, which should be wide enough to allow the posts to carry the shaft with small collars between the ends of the can and the posts. These collars may be made of small spools, such as twist spools. A strip of spring brass *T*, about ½ in. wide is fastened to the base with a round brass screw, or a binding post may be used, which would be more convenient in making connections. The upper end of the strip is curved outwardly, and the strip is located to press lightly but evenly upon the end of the can, so as to make good contact.

The other contact, which is movable, is made from a piece of spring brass wire of about 1-16th in. diameter. A piece about seven or eight inches long will be required, as several turns must be made near the center to form a bearing for the rod upon which it slides. On the end which rests upon the can must be soldered a short piece of strip brass like that used for the first contact. A piece of brass rod like that used for the

shaft and a little longer than the round surface of the can must be supported at the ends by small blocks in which are bored holes only part way through. The sliding contact is put on the rod, and the rod placed in position by fastening the blocks to the base with screws. About two inches away from the rod is fastened a strip of wood, in the upper edges of which are cut slots spaced the same distance apart as the call stencils on the can. The end of the sliding contact rests in the proper slot to sound the desired call.

The stencils for the different calls are made from thick, strong manilla paper, which is cut into strips about 1 in. wide and long enough to go around the can and have a small lap at the joint. The speed at which the can will turn is first ascertained, and the letters of the call are then cut out, or rather spaces corresponding to the dots and dashes making up the letters. The strip is then coated on both sides with shellac and immediately placed in position around the can. It should be smoothed down so as to present an even surface to the contact as it revolves. Any shellac which may run out into the open spaces should be removed, so that the can will make a good electrical contact with the sliding arm. As many of these paper stencils are made as there are stations to call. After all the stencils are in place the outside surfaces can again be coated with shellac, which with the paper makes a good insulation where the arm is not to touch the can.

To rotate the can, part of the train of gears from an old alarm clock will be needed. Movements of this kind can generally be had for the asking from many jewelry stores. The part of the train to be retained begins with the mainspring shaft and the three shafts and gears directly connected to it. The mainspring shaft projects through the side for an inch or more, and on this projecting end should be secured as large a wooden spool as can be made to hold on the shaft. One way of fastening to the shaft is to file a flat place on the shaft and put a screw through the spool until it reaches the flat space, thus acting as a set screw. On the shaft at the other end of the train a smaller wooden cylinder is fitted and fastened by means of two or three small screws, the heads of which bear on the gear on that shaft. This cylinder can be split for convenience in fitting, and the two parts united by glue, which will hold if reinforced by several turns of fine wire, as the duty is not heavy. From this pulley is run a belt made of tape which also runs over one end of the stencil can. The clock movement must be fastened to the base so that the tape belt will run in line.

To move the gears, and in turn the stencil can, a cord is attached to the spool on the mainspring shaft, the end of which is carried through the hole in the base and a weight attached. The weight is rigged just the same as in old-time clocks, by means of the awning pulleys, one being attached to the weight and one to the under side of the base. The quickest way to rewind the cord on the spool after it is all run out is to pull in the cord and wind it around the spool by hand.

In connecting this calling device into the circuit, it may be wired in shunt with the regular key, and cut out by means of a switch when not wanted. In this way it can be located in any convenient place in the room. It seems quite probable that this device could be used for wireless telegraphy if made a little heavier so as to take the larger current, but never having tried it for that work, cannot state absolutely that it would be satisfactory when used in that way.

STARTING A GAS ENGINE.

This is the question that comes up many times in the mind of the young engineer, when he finds out after a number of fruitless efforts to "get her started," that she will not turn her wheels or "go." Now there is a reason for this condition of affairs when the gas engine refuses to obey the behest of the driver, and I propose in this article to give such plain instructions that the novice may be assisted in starting the gasolene engine.

In the first place, see that the compression is right, admission valve is tight and will admit only enough of the mixture (gasoline and air) to make a charge that will take fire from the sparker and move the piston forward. In the next place see that the sparker is clean and will make a bright spark at white heat when the contact is broken and at the right time. And right here I want to say to you that "in time" means to go if everything else is right, and "out of time" means not to go if everything else is all right.

The valves of the engine must be kept well ground down with emery and oil so as to preclude a possible leak, for this will very seriously weaken the power of the engine even after it has started. The spark must be made when the connecting rod of the engine is on the "up stroke," with the crankshaft about three inches below the horizontal line of the center of the index, and herein lies the whole secret of the greatest efficiency from the least amount of gasoline. As there is an interval of time after the spark is made until it ignites the charge, it is very evident that the movement of the machinery continues and the moment of ignition should take place when the compression is greatest, and this will be when the piston is on its farthest "instroke," *i. e.*, in perfect line with the center of the cylinder. But if the charge be ignited at this point the engine will not develop the greatest power, as the interval spoken of will elapse and the piston will have started on its "out stroke," thereby not getting its full force of the expansive gases, liberated by combustion of the air and gasoline.

Therefore, it will readily be seen that we must allow for the interval spoken of if we would get full returns for the energy we use in propelling the motor. I have tried to make this plain and very easy to under-

stand, and I hope my efforts will help out some experienced or inexperienced gasoline engineer, who has trouble with his engine, either in starting or developing the power at which it is rated.—"The Gas Engine."

CORRESPONDENCE.

No. 140. TORONTO, CAN., MARCH 15, 1906.

I have some clean brass castings which I wish to dip bright. Will you kindly let me know the proportions of sulphuric acid and nitric acid to use for the dipping solution? Also, will it be necessary to pickle the castings first, and if so, what is the formula for the pickling solution? B. J.

The following is from "Polishing and Plating of Metals," by Herbert J. Hawkins: "A bright dip is one which is designed to obtain radically different results from the dull or satin finish dips. It is so composed that the metal, while corroded, is not covered with a dull sub-oxide, but remains bright enough to reflect the light more or less from the innumerable points left by the acid, so that while we have a matted surface, it leaves the metal bright and shining but not polished. Speed of operation and uniformity are the essentials in bright dipping, as the acids act very quickly, and the longer the work is allowed to remain in the dip, the more corroded and larger will be the granulations of the surface of the metal, and the duller will be the effect produced. Another very important point is the ability to keep water out of the dip without unduly slowing the output of the work. Water will convert a bright dip into a satin finish dip, if present in a very small quantity, thus destroying the dip, as it will no longer give the best results as a bright dip. * * * Bright dips are used to obtain two or three distinct effects, which depend chiefly on the amount of time the acids are allowed to work upon the metal; a second or two will give a bright effect, twice that length of time will give a very bright surface, while six or seven seconds will give a comparatively dull effect which is almost a satin finish. This time is given for a new dip which is working rapidly upon metal very easily corroded, such as the brass generally used in gas fixtures. As the dip gets older the time must be increased to obtain similar effects, and metals less easily attacked must also have longer time.

"The bright dip for copper, brass, bronze or German silver is:

Sulphuric acid	100 parts by weight.
Nitric acid	75 " " "
Common salt	1 " " "

"After dipping, the articles should be very quickly rinsed in cold water, then in hot water and dried in sawdust. Boxwood or hardwood sawdust must be used; soft wood sawdust will not do, as it tarnishes the work badly.

"It may be stated generally that work to be dipped should be dry and free from grease. It is the usual practice with brass or bronze goods to first hot potash them, then swing in the air until dry, then immerse in the bright dip, then into clean running water, then in boiling water and finally dry in sawdust. In this way the potash dries quickly upon the surface of the work, forming a film which protects it from the air while being conveyed to the bright dip, * * * thus producing brighter and more even results in the finish.

Pickles are used to remove sand or grease from rough castings, preparatory to polishing or plating. A pickle for brass or copper that is not to be polished is:

Nitric acid	200 parts by weight.
Common salt	1 " " "
Lampblack	2 " " "

After pickling until clean, hot potash them, swing in the air until dry, then into the bright dip, etc., as above.

No. 141 WOLFBORO, N. H., MARCH 31, 1906.

I have two telephones made of just two bi-polar receivers, with a suitable call. I have tried it on a line about 150 feet long, of No. 12 galvanized wire, but I should like to hear a little better. I can talk over it now fairly well, but it is not near as loud as a commercial telephone. Could a battery be connected into the circuit with or without an induction coil, and give better results? If so, please send a diagram of the connections. Also, please send a diagram of the connections for a magneto call line of two stations about 1½ mile apart. G. F. B.

The bi-polar receivers which you are using contain permanent magnets which, whenever the diaphragm vibrates as when spoken into, set up feeble alternating currents in the line and so influence each other. The addition of batteries to the circuit would cause currents to flow which would interfere with those set up by the magnets and serve to prevent the proper action of the receivers. Batteries can only be used in connection with the microphone transmitters. The diagram for the magneto circuit accompanies this answer.

No. 142. NEW LONDON, CONN., APRIL 9, 1906.

Will you kindly advise me how to take the solidly glued fingerboard from the neck of a violin? Also state how or by what process patterns, such as boat patterns, are made. Can you state where a varied line of cheap but reliable trade text books can be bought? J. M. H.

As the glue holding the finger board to the neck is old and absolutely dry, the first operation would be to use the edge of a thin-bladed knife as a wedge and get a crack started. Wet the crack with warm water, and after a few minutes use the knife again, continuing the process until eventually the glued surfaces will part.

The process for making boat patterns is quite fully described in the first chapter of the description of the tender contained in the March, 1906, number.

It will be necessary to know the subjects upon which books are desired before specific information can be given.

SCIENCE AND INDUSTRY.

A little chemical compound named "zorene," discovered by a Hungarian chemist, is said to possess very remarkable properties. A piece of friable slag, after immersion in it, defied the blow of a heavy hammer. Immersing substances in the compound seems to render them impervious to water, as shown by tests, in which no additional weight was observed after long soaking in water. Two pieces of steel, one of which had been soaked in the liquid, were submitted to an ammonia test equal to an exposure of five years in the air. The soaked specimen showed no effects from the ammonia, while the other was badly corroded. If these statements prove true the discovery should have considerable commercial value.

A way has been devised of extracting from coal tar many of the rapid developers so widely used by photographers, says the "Mining World". Besides these, there have also been discovered the perfumes just as fragrant as the natural odors of flowers, from which, indeed, they cannot be distinguished by smell. The host of artificial flavors from the same source, has almost completely displaced the natural products. True fruit flavors are rarely employed nowadays, wittingly or unwittingly. Their place is taken by coal-tar derivatives which are exactly the same in taste and chemical composition. Among the more remarkable of these is saccharin, sweeter than sugar by several hundred times and quite indispensable in the treatment of certain diseases which are caused by an excess of sugar in the system.

Consul-General Ragsdale writes from Tientsin that the Chinese Government has arranged to establish several stations throughout China for experiment with Marconi's system of wireless telegraphy and instruct Chinese operators in working the same. The apparatus has been installed on four Chinese men-of- war at Shanghai and at the three North China cities of Tientsin, Peking, and Paotingfu, the radius of action being about 150 miles and the cost about $15,000. An Italial officer has been appointed, not only instructor, but also as an engineer to superintend the installation, and under whom a number of students have already been detailed to act as operators and learn the art of management. It is also said that the viceroys throughout the Empire have been directed to consider the advisability of establishing other stations to work in conjunction with those above mentioned.

The property of dissolving metallic oxides makes it useful in soldering and brazing metals, as it cleans the surfaces to be joined so that the solder runs and fills the joint between them. In welding metals it is used as a flux.

The use of acetylene gas as an illuminant in Germany has not come up to expectations, and the latest use they have put it to is as an explosive material. The mixture is confined in a chamber and ignited by means of an electric spark. It can be used in blasting and it is said that the rock is not thrown out, but rent with innumerable cracks, so that it can be easily removed afterwards. About 1.7 ounces of carbide, which produce about 16 quarts of acetylene gas, is used for each cartridge.

A choice case of the newspaper bull in the technical china shop is the following quoted from an Indiana paper: "The power house will be a place of miracles to the lay mind, which may then watch electricity sucked from the air at 370 volts and multiplied to 33,600 volts by processes which electricians know as phenomena and not as science. The reason why is apparently beyond mortal ken, but the results satisfy commercial purposes, and the tendency of the great mass is 'to let it go at that.' The transformer that by the power that is called 'induction' for lack of a better name, will step up the number of volts, will be inclosed in oil, and the apartment walled in will have doors so that if it gets out of repair it can be easily and safely handled. It will be dangerous to approach it within six feet, and it will be controlled at a safe distance by those in charge."

A good cement for making tight joints in pumps, pipes, etc., can be made of a mixture of 15 parts of slaked lime, 30 parts of graphite and 40 of barium sulphate. The ingredients are powdered, well mixed together, and stirred up with 15 parts of boiled oil. A stiffer preparation can be made by increasing the proportions of graphite and barium sulphate to 30 or 40 parts respectively and omitting the lime.

Another cement for the same purpose consists of 15 parts of chalk and 50 parts of graphite, ground, washed and reground to fine powder. To this mixture is added 20 parts of ground litharge, and the whole mixed to a stiff paste with about 15 parts of boiled oil. This last preparation possesses the advantage of remaining plastic for a long time when stored in a cool place. Finally, a good and simple mixture for tightening screw connections is made from powdered shellac dissolved in 10 per cent ammonia. The mucinous mass is painted over the screw threads, after the latter have been thoroughly cleaned and the fitting is screwed home. The ammonia soon volatilizes, leaving behind a mass which hardens quickly, makes a tight joint, and is impervious to hot and cold water.